

**GENERAL CERTIFICATE OF SECONDARY EDUCATION**  
**TWENTY FIRST CENTURY SCIENCE**  
**ADDITIONAL APPLIED SCIENCE A**  
Materials and Performance (Higher Tier)

**A336/02**

**Wednesday 27 January 2010**  
**Afternoon**

**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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**MODIFIED LANGUAGE**

**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.

**BLANK PAGE**

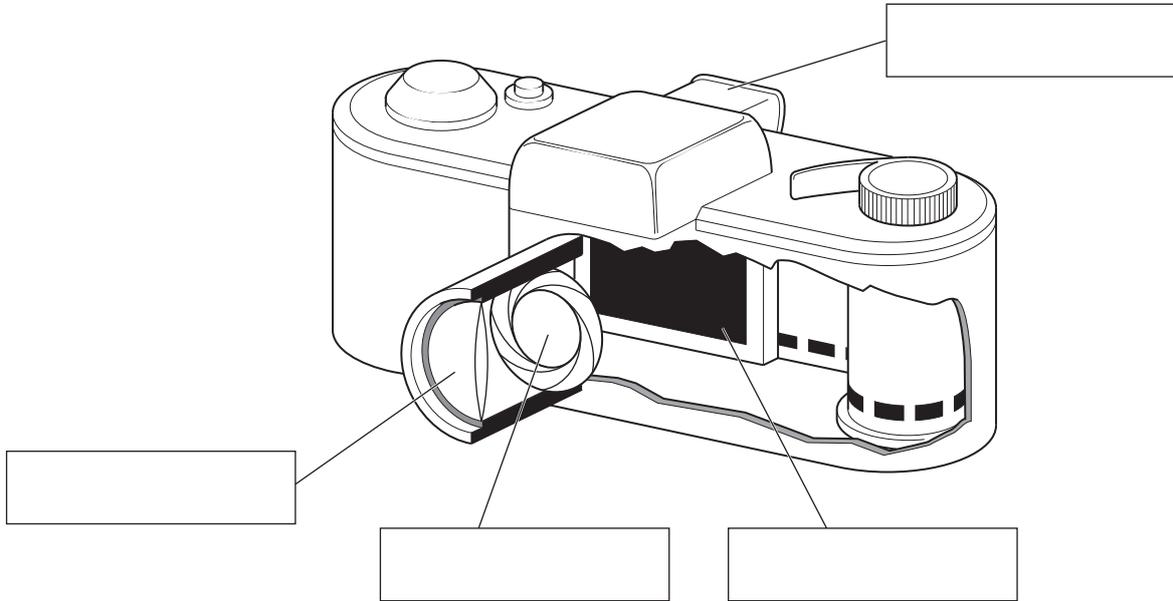
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Answer **all** the questions.

1 Robert is a cameraman.

(a) This diagram shows Robert's camera.

Label the **lens**, **shutter**, **aperture** and **viewfinder**.



[4]

(b) (i) Robert explains how the camera lens produces an image.

Complete these sentences. Choose words from this list.

- circle      eclipse      focus      image      inverted  
 line      object      real      reflected      upright      virtual

'Parallel rays of light from a distant object are brought to a .....  
 on the film. This makes an ..... which is smaller than the  
 object. It is ..... and .....

[4]

(ii) The material of the lens makes the light rays change direction.

Give the name of this effect.

answer .....

[1]

(iii) The surface of the lens has a coating.

Describe the purpose of this coating.

.....  
 .....

[1]

[Total: 10]

Turn over

2 Stefan is a science teacher. He wants his class to compare the expansion of some metal bars.

(a) He first predicts how much a steel bar will expand.

The bar is 1.5 m long and Stefan expects its temperature to rise by 400 °C.

The expansion index of mild steel is 15.

Use the formula below to predict the expansion of the bar.

Show your working.

$$\text{expansion (mm)} = \frac{\text{length of bar (m)} \times \text{temperature rise (}^\circ\text{C)} \times \text{expansion index}}{1000}$$

expansion = ..... mm [2]

(b) Stefan carries out the same experiment with different metals.

He gets these results.

expansion of metal bar in mm			
metal	test 1	test 2	test 3
aluminium	10	20	12
iron	6.0	7.0	6.5
copper	9.0	10	10
steel	8.0	9.0	10

(i) The students notice an outlier in the data.

Put a ring around the outlier.

[1]

- (ii) Stefan asks his students to write down the metals in order of expansion.  
 Use the data in the table to write down the metals in order of expansion.  
 Start with the highest expansion.

highest expansion

↑

↓

lowest expansion

[1]

- (iii) Four students are unsure about the correct order of metals for expansion. They say what they think makes the order unreliable.

**Bess**  
 There were three tests for each metal.



**Aled**  
 The data ranges overlap.



**Carlos**  
 There is an outlier in the data.



**Davina**  
 Steel is an alloy.



Which student has the correct reason for being unsure? ..... [1]

[Total: 5]

3 Read this passage.

A factory makes drink cans.

An alloy of aluminium is used. The alloy is made by adding manganese and magnesium to the aluminium to make it stronger and more ductile.

The alloy reaches the factory in sheets. Each sheet is pressed to make discs. Each disc is formed into a shallow cup, then rammed through a tungsten carbide ring to make a hollow cylinder.

Answer these questions, using information in the passage.

(a) The metal used to make drink cans is an alloy. What is an alloy?  
..... [1]

(b) Give **two** reasons for using aluminium **alloy** instead of pure aluminium.  
Use information from the passage.

1 .....

2 ..... [1]

(c) Describe what 'ductile' means.  
..... [1]

(d) The shape of the alloy is changed several times.

The alloy is formed into four different shapes in the process of making a can.

Write them down in the correct order.

1 .....

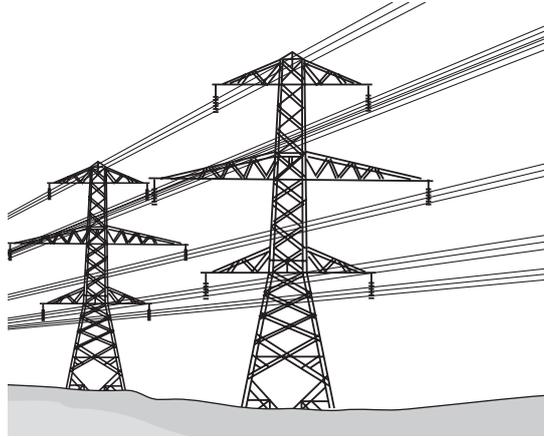
2 .....

3 .....

4 ..... [2]

[Total: 5]

- 4 Electrical power cables include wires made of a combination of aluminium and steel.



- (a) Miriam is studying electrical conductance.

- (i) Describe how she could measure the **electrical conductance** of a cable. Use a circuit diagram to show how to connect the components. Include an ammeter and a voltmeter in your circuit. Label the components and the sample to be tested.

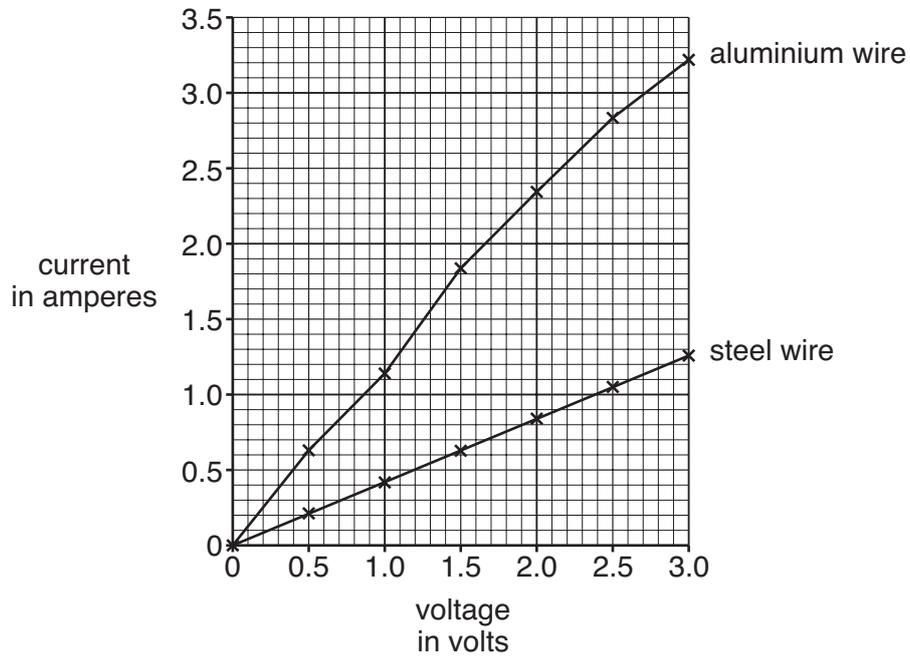
.....

.....

..... [3]

Miriam has test results for steel and aluminium wires.

The graph shows her results.



- (ii) Use Miriam's results to calculate the conductance of the **steel** wire. Show your working.

$G = I/V$

conductance of steel wire = ..... S [2]

- (iii) Miriam looks at the graph.

What **two** things can she say about the conductance of aluminium compared with the conductance of steel?

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

- (b) (i) Aluminium is used for power cables because it has low density and high electrical conductance.

Give **another** example of a material which by itself has a combination of quite different properties but together they make the material suitable for a particular purpose.

Your answer should include the reason each property is needed.

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

- (ii) Power cables include strands of steel to improve their tensile strength. The aluminium strands have low density so the cables can be supported overhead. The **mechanical properties** of steel and aluminium are said to be **complementary**.

Give **another** example where materials with complementary properties are needed. Your answer should clearly state:

- the properties needed for a particular purpose
- the property of each material which is useful for this purpose.

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

[Total: 11]

5 Paul is a fleet manager for company cars. Impact sensors are fitted to the cars. One car hits a tree and stops. The driver returns the car to Paul. In the collision, the car's impact sensor shows that the collision took 0.12 seconds and that the average force was 140 000 N. Paul wonders if the driver was speeding. He calculates the speed of the car before the collision.

(a) (i) Calculate the speed of the car.

Use this formula.

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

The mass of the car and driver is 1080 kg.

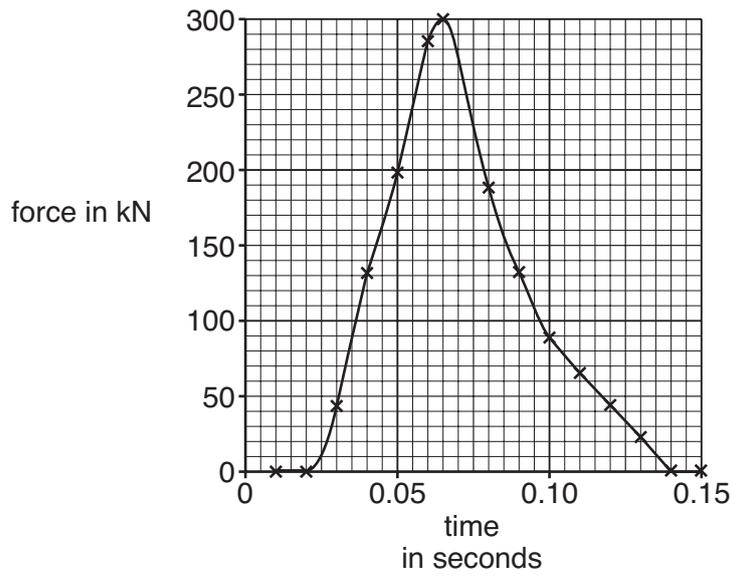
Show your working.

speed of car = ..... m/s [3]

(ii) The average force in a collision is reduced if the driving speed is reduced. Describe another way of reducing the average force in a collision.

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

(b) This graph shows some of the data from the impact sensor.



The graph can be used to find the change in momentum during the collision.

What feature of the graph shows the change in momentum?

..... [1]

[Total: 5]

**END OF QUESTION PAPER**

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