

**GENERAL CERTIFICATE OF SECONDARY EDUCATION**

**TWENTY FIRST CENTURY SCIENCE**

**ADDITIONAL APPLIED SCIENCE A**

Materials and Performance (Higher Tier)

**FRIDAY 25 JANUARY 2008**

Morning  
Time: 45 minutes

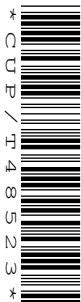
Candidates answer on the question paper.

**Additional materials (enclosed):**

None

Calculators may be used.

**Additional materials:** Pencil  
Ruler (cm/mm)



Candidate  
Forename

Candidate  
Surname

Centre  
Number

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Candidate  
Number

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**INSTRUCTIONS TO CANDIDATES**

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use blue or 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.
- Do **not** write outside the box bordering each page.
- Write your answer to each question in the space provided.

**INFORMATION FOR CANDIDATES**

- The number of marks for each question is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **36**.

**FOR EXAMINER'S USE**

Qu.	Max.	Mark
1	6	
2	12	
3	6	
4	5	
6	7	
<b>TOTAL</b>	<b>36</b>	

This document consists of **11** printed pages and **1** blank page.

Answer **all** the questions.

- 1 Blanca plays in a band.



- (a) When Blanca practises alone the sound intensity is 70 dB.

The sound intensity of a normal conversation is about 60 dB.

How loud is Blanca's music compared with a normal conversation?

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

**half as loud**

**slightly louder**

**twice as loud**

**ten times as loud**

[1]

- (b) The band practice is very loud. It does not hurt, but Blanca finds it hard to hear for some time afterwards.

Complete the sentence. Choose the **best** value from the list.

- (i) The loudness during the practice is about ..... dB.

**10 dB**

**60 dB**

**90 dB**

**150 dB**

[1]

- (ii) Some musicians hear a ringing noise all the time. This condition can be caused by loud music.

Write down the name of the condition. .... [1]

(c) A neighbour complains about the band rehearsals.



Put a tick (✓) in the box next to the **best** explanation for this problem.

- Older people cannot hear very high frequencies.
- The band needs more practice.
- Low frequency sounds penetrate building structures.
- The human ear is most sensitive to sounds at 2000 Hz.

[1]

(d) Blanca needs to soundproof the practice room. Suggest how she could do this.

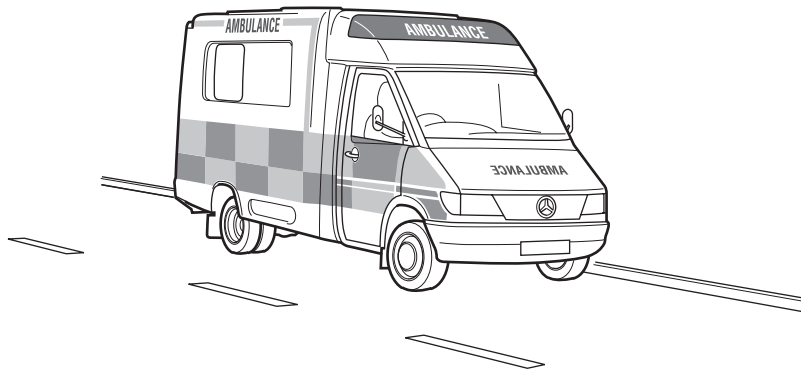
Your answer should include:

- a suitable **material** for soundproofing
- how Blanca should use the material in the room.

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

[Total: 6]

2 Some road vehicles, such as ambulances, are made with crumple zones.



(a) (i) Put ticks (✓) in the boxes next to the **two** best reasons for having a crumple zone.

- so no one drives a damaged ambulance
- so other vehicles are not damaged in a collision
- to increase the time it takes to slow down
- to decrease the force of any impact
- to strengthen the front of the ambulance

[2]

(ii) A crumple zone is made of a metal alloy.

Write down **another** device that improves road safety.

Describe how the mechanical properties of its material help to improve safety.

Device .....

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

(b) An ambulance travelling to an emergency sometimes has a high momentum.

What **two** quantities do you need to calculate the momentum?

1. ....

2. ....

[2]

(c) The speed of the ambulance changes from 60 mph to 30 mph.

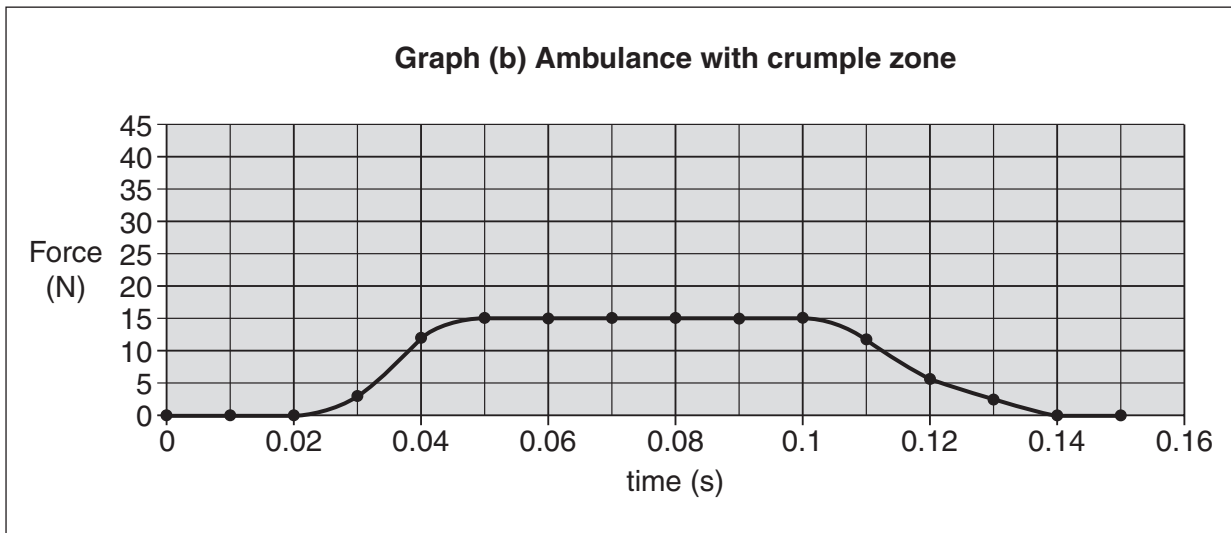
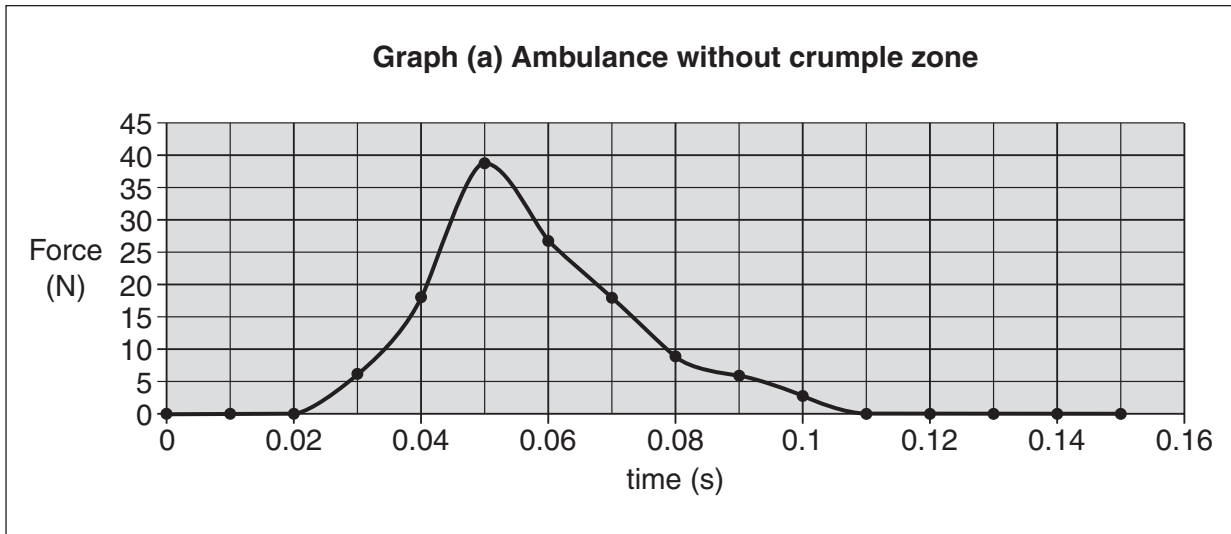
Complete the sentence.

Choose words from this list.

- half                  twice                  three times                  four times**

The momentum of the ambulance at 60 mph is ..... the momentum at 30 mph. [1]

(d) Two toy ambulances were tested by crashing them against a sensor to measure the forces during each collision.



Both ambulances have the same mass and speed when they hit the sensor. The area under each curve is the same.

(i) What does the area under the curve represent?

..... [1]

The maximum force in Graph (b) acts for 0.05 s.

- (ii) Show that the change in momentum of the vehicle while the maximum force is acting is about 0.8 Ns.

Use the formula:

$$\text{change in momentum} = \text{force} \times \text{time}$$

$$\text{change in momentum} = \dots\dots\dots \text{Ns} \quad [2]$$

- (iii) The mass of the toy vehicle is 0.3 kg.

Use your answer to (ii) to calculate the change in velocity while the maximum force is acting.

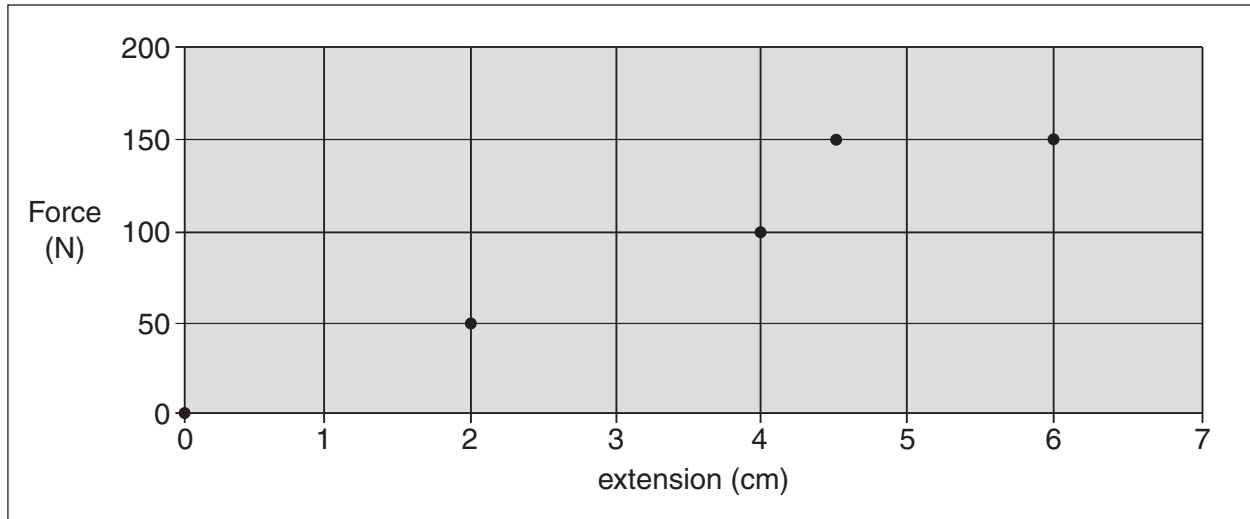
$$\text{change in velocity} = \dots\dots\dots [2]$$

[Total: 12]

3 Sonia tests materials used for the strings of badminton rackets.

She measures the extension of the string for different forces.

Her results are plotted on the graph.



(a) (i) One of the data points on the graph is an **outlier**.

Put a **ring** around the outlier.

[1]

(ii) Complete the graph by drawing the line of best fit through the points.

[1]

(b) Sonia uses the equation  $F = kx$  to find the value of the constant,  $k$ .

Calculate the value of the constant.

$k = \dots\dots\dots$  N/cm [2]

(c) When Sonia stretches the strings, they store energy.

Use the graph to calculate the energy stored in the stretched sample when a force of 100 N is applied.

Give your answer in joules.

energy =  $\dots\dots\dots$  J [2]

[Total: 6]

4 Material properties change when there are large temperature changes.

Food containers need to function over a wide range of temperatures.

Complete the sentences. Choose the **best** words from the list.

**brittle**      **colourful**      **strong**      **less dense**      **expensive**      **tough**

(a) Polymers expand when heated. They become .....

At low temperatures polymers become ..... [2]

(b) Some materials are chosen so that their thermal properties **match** each other.

Describe an example of an artefact whose materials are selected for **matching thermal behaviour**.

- Explain why the thermal behaviours must match.
- Use a diagram to help your answer.

.....

.....

.....

..... [3]

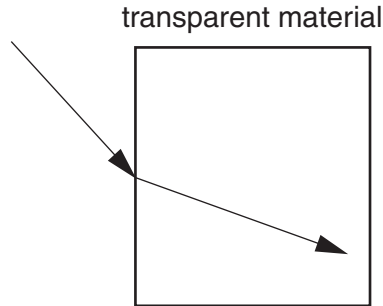
[Total: 5]



5 Carl is training to be a cameraman. He is learning about lenses.

(a) Carl looks at the diagram.

It shows how a ray of light passes from the air into a transparent material.



The direction of the ray changes as it enters the transparent material.

Which of these words describes this change?

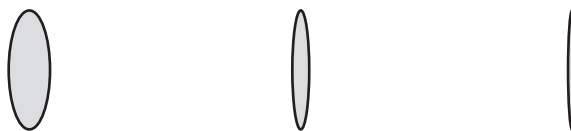
Put a tick (✓) in the correct box.

- diffraction
- dispersion
- reflection
- refraction

[1]

(b) Carl reads that lenses of the same focal length can be made thinner, if a different material is used.

These lenses have the same focal length. They are made of different materials.



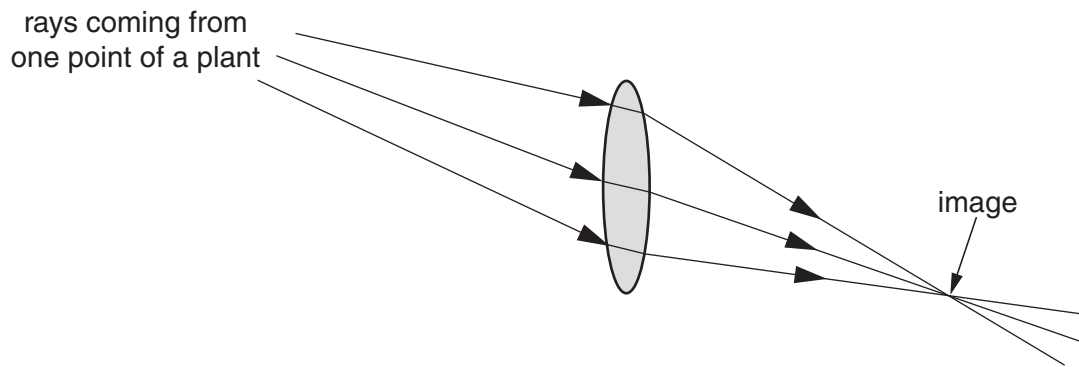
Explain how using a different material allows a lens to be made thinner but with the same focal length.

.....

.....

..... [2]

(c) Carl takes some photographs of a plant.



The diagram shows how his camera lens produces an image of one point on the plant.

He moves the plant **towards** the lens and refocuses the image. This alters the image.

(i) Describe **two** changes in the image.

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

(ii) Describe what adjustment is made in the camera to focus the image correctly.

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

(d) Carl puts down his camera and inspects the plant.

As he gets closer his eyes adjust to focus the image of the plant.

Describe what happens in his eyes to alter the focus.

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

[Total: 7]

**END OF QUESTION PAPER**

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