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Centre Number		Candidate Number	
Candidate Signature			

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General Certificate of Secondary Education  
June 2006



**PHYSICS (MODULAR) SPECIFICATION A**  
**Written Paper**  
**Higher Tier**

**3453/H**  
**H**

Friday 16 June 2006 9.00 am to 10.30 am

<p><b>For this paper you must have:</b></p> <ul style="list-style-type: none"> <li>• a ruler</li> </ul> <p>You may use a calculator.</p>
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Time allowed: 1 hour 30 minutes

**Instructions**

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Show all your working in calculations.

**Information**

- The maximum mark for this paper is 90.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use			
Number	Mark	Number	Mark
1		7	
2		8	
3		9	
4		10	
5		11	
6		12	
		13	
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

**There are no questions printed on this page**

**FORCES**

1 This was a newspaper headline in September 2004:

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The newspaper reported an unexplained radio signal.  
The signal was said to be the first contact by an intelligent alien civilisation.  
The signal was detected in Puerto Rico.

(a) (i) Some scientists have been searching for signals such as this for over forty years.

What is this search called?

.....

(ii) Name the device which was used to detect the signals.

.....

*(2 marks)*

(b) Scientists have sent probes to investigate planets in our own solar system. The probes were looking for evidence that there is, or has been, life on another planet.

What kind of evidence were they looking for?

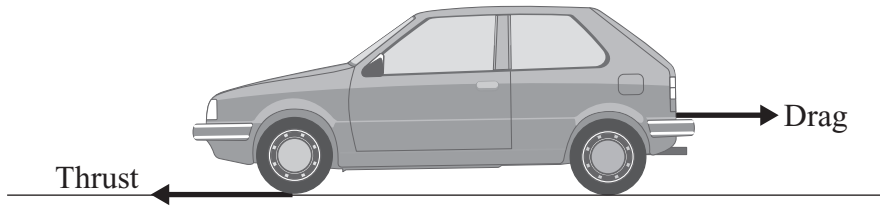
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*(3 marks)*

**5**

**Turn over ►**

2 The diagram shows the horizontal forces acting on a car travelling along a straight level road.



(a) What is happening to the speed of the car when the thrust is:

(i) larger than the drag;

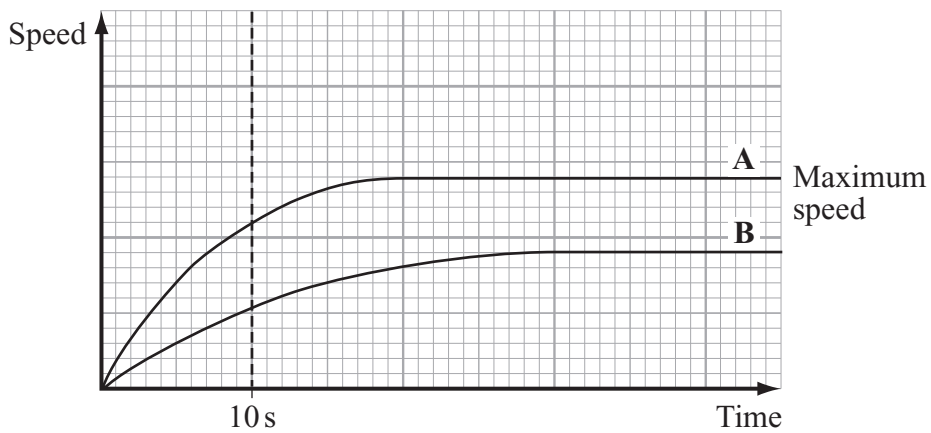
.....

(ii) smaller than the drag?

.....

(2 marks)

(b) The graph shows how the speed of two cars, **A** and **B**, changes with time.



(i) Which car, **A** or **B**, has the greater acceleration over the first 10 seconds?  
Explain your answer.

Car with greater acceleration .....

Explanation .....

.....

.....

.....

(2 marks)

- (ii) Explain, in terms of the forces acting on the car, why a car reaches a maximum speed.

*To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

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(3 marks)

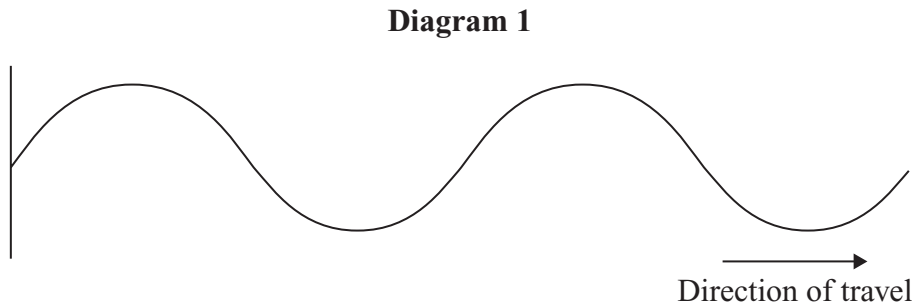
7

**Turn over for the next question**

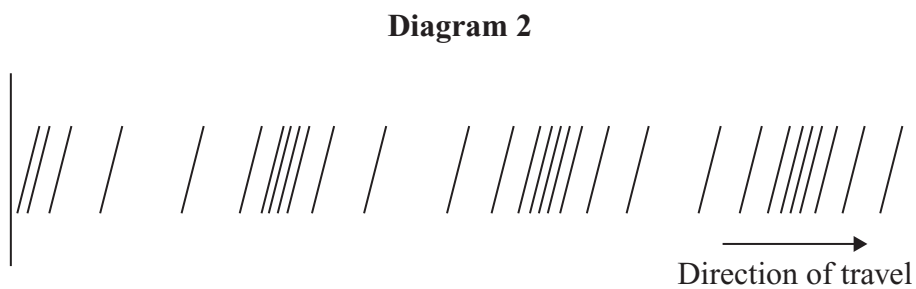
**Turn over ►**

## WAVES AND RADIATION

- 3 A wave can travel along a rope when one end is disturbed.  
This type of wave is shown in **diagram 1**.



- A different type of wave can travel along a spring when one end is disturbed.  
This type of wave is shown in **diagram 2**.



- (a) What type of wave is shown in:

(i) **diagram 1**; .....

(ii) **diagram 2**? .....

(2 marks)

- (b) Microwaves are used for cooking.

Explain, as fully as you can, how microwaves cook food.

.....

.....

.....

.....

(2 marks)

(c) Infra red radiation is also used for cooking.

State **two** ways in which microwaves are similar to infra red radiation.

1 .....

.....

2 .....

.....

(2 marks)

(d) Microwave ovens should be checked for leaks, because microwaves are dangerous.

How are microwaves dangerous?

.....

.....

.....

.....

(2 marks)

<b>8</b>

**Turn over for the next question**

**Turn over ►**

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**FORCES AND MOTION**

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**4**

Question 4 has not been reproduced here due to third-party copyright constraints.



8

**Turn over for the next question**

**Turn over ►**

5 In the early part of the twentieth century, Alfred Wegener suggested that South America and Africa could once have been joined.



(a) (i) Give **two** pieces of evidence which suggest that South America and Africa were once joined.

1.....

2.....

(2 marks)

(ii) Before Wegener suggested his theory, how did most scientists explain the shape of the continents?

.....

.....

.....

(2 marks)

(b) In the past, many scientists believed that the continents were too big to move. They did not accept Wegener’s theory.

Scientists now believe that the movement of continents can be explained in terms of the movement of *tectonic plates*.

(i) What are *tectonic plates*?

.....

.....

(1 mark)

(ii) What causes *tectonic plates* to move?

.....

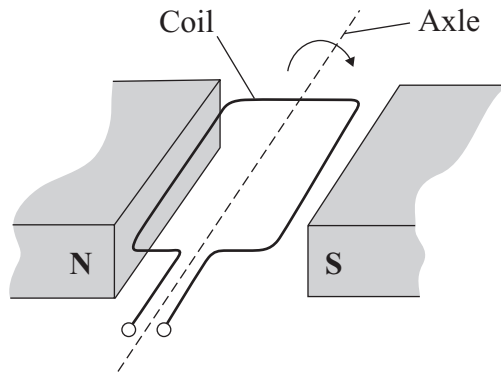
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(2 marks)

**QUESTIONS RELATING TO PREVIOUSLY TESTED MODULES**

- 6 The diagram shows part of a simple a.c. generator.  
When the coil rotates, a potential difference (voltage) is induced across the ends of the coil.



- (a) Suggest **three** ways of increasing the induced potential difference.

- 1 .....
- 2 .....
- 3 .....

*(3 marks)*

- (b) Power stations generate electricity on a large scale.  
Many power stations burn fossil fuels.

Give **two** environmental problems caused by burning fossil fuels.

- 1 .....
- .....
- 2 .....
- .....

*(2 marks)*

5
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**Turn over ►**

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**FORCES**


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- 7 (a) Forces are measured in units called newtons.

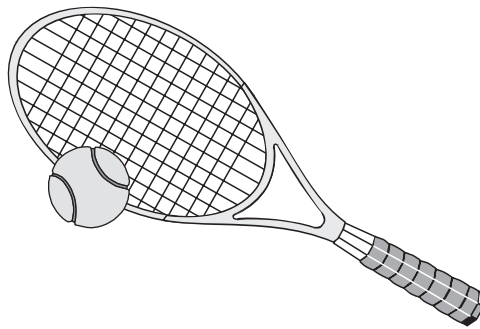
Complete the sentence.

A newton is the force needed to give a mass of one .....

an increase in velocity of one metre per second every .....

(1 mark)

- (b) The diagram shows a tennis racket hitting a stationary ball of mass 0.05 kg.  
The force of the racket on the ball is 200 N.



- (i) Calculate the acceleration, in  $\text{m/s}^2$ , of the tennis ball.

.....

.....

.....

.....

.....

Acceleration = .....  $\text{m/s}^2$   
(3 marks)

(ii) The racket is in contact with the ball for 0.02 s.

Calculate the speed, in m/s, of the tennis ball as it leaves the racket.

.....  
.....  
.....  
.....  
.....

Speed = ..... m/s  
*(3 marks)*

(c) The kinetic energy of the tennis ball is 90 J as it passes over the net.

Calculate the speed, in m/s, of the tennis ball as it passes over the net.

.....  
.....  
.....  
.....  
.....

Speed = ..... m/s  
*(3 marks)*

<b>10</b>

**Turn over for the next question**

**Turn over ►**

8 In the 1920s, Edwin Hubble observed that light from distant galaxies experiences *red shift*.

(a) (i) What is *red shift*?

.....  
.....

(ii) What causes the light from distant galaxies to experience *red shift*?

.....  
.....

(2 marks)

(b) The *red shift* increases with the distance of the galaxy.

What does this suggest about the Universe?

.....

(1 mark)

(c) The study of the light from distant galaxies led to the *big bang theory*.

What is the *big bang theory*?

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.....  
.....  
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(2 marks)

5
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**Turn over for the next question**

**Turn over ►**

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**WAVES AND RADIATION**

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9 (a) Radio waves can sometimes be received in the shadow of hills. TV waves from the same transmitter cannot be received.

(i) Explain why the radio waves can be received.

.....  
(1 mark)

(ii) Explain why the TV waves cannot be received.

.....  
.....  
(2 marks)

(b) A radio programme is broadcast on the long wavelength (LW) band at a frequency of 200 kHz.

Radio waves travel at a speed of 300 000 000 ( $3 \times 10^8$ ) m/s.

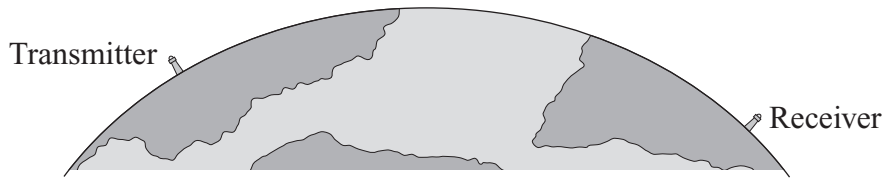
Calculate the wavelength, in metres, of the radio waves.

.....  
.....  
.....  
.....

Wavelength = ..... m  
(3 marks)



- (c) Radio waves can be received many hundreds of kilometres away from the transmitter, even though the Earth is curved.



Explain how the radio waves travel from the transmitter to the receiver.

.....

.....

.....

.....

(3 marks)

<b>9</b>

**Turn over for the next question**

**Turn over ►**

**10** This question is about the use of radioactive *isotopes*.

(a) What are *isotopes*?

.....

.....

(1 mark)

(b) The isotope americium–241 is used in smoke alarms.  
Americium–241 emits *alpha particles* and has a *half-life* of 432 years.

(i) What is an *alpha particle*?

.....

.....

(1 mark)

(ii) What is meant by *half-life*?

.....

.....

(1 mark)

(iii) Use the information given to explain why americium–241 is suitable for use in a smoke alarm.

.....

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.....

(2 marks)

(c) The isotope technetium-99 is used as a medical tracer.  
Technetium-99 emits *gamma rays* and has a half-life of 6 hours.

(i) What are *gamma rays*?

.....  
.....

(1 mark)

(ii) Use the information given to explain why technetium-99 is suitable for use as a medical tracer.

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(2 marks)

8

**Turn over for the next question**

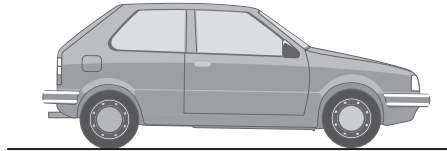
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**FORCES AND MOTION**

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- 11** The drawing shows a car travelling on a long, straight and level road.  
The mass of the car is 1000 kg.



- (a) The car has momentum of 25 000 kg m/s.

- (i) Calculate the speed, in m/s, of the car.

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Speed = ..... m/s  
(3 marks)

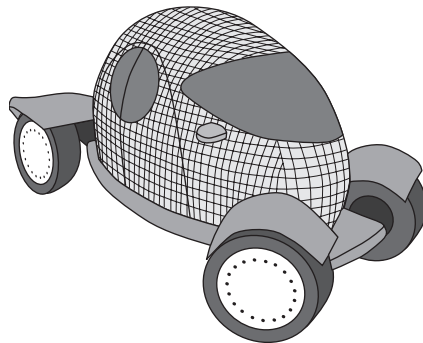
- (ii) A braking force of 5000 N is applied to the car.

Calculate the time taken, in seconds, for the car to stop.

.....  
.....  
.....  
.....

Time taken ..... s  
(3 marks)

- (b) The European Commission has ordered car makers to design *soft cars*. These cars will cause less serious injuries to pedestrians. The drawing shows one design.



The metal frame of the car is covered with a skin made of hundreds of air-filled plastic pads.

Explain how the *soft car* will reduce injuries to a pedestrian who is hit by it.

*To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

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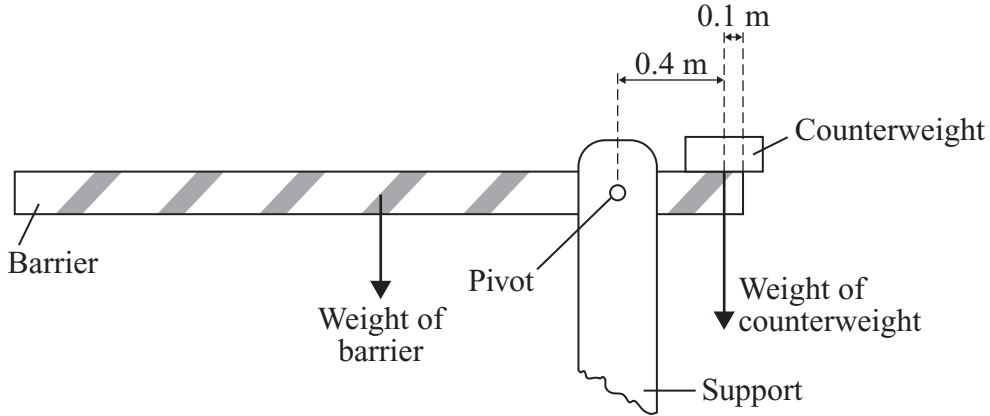
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(4 marks)

10
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- 12 The diagram shows a car park barrier.  
It also shows the forces acting on the barrier, which is balanced in this position.  
The barrier is the same width all along its length. It is 4 m long.  
The counterweight has a weight of 450 N.



Calculate the weight, in newtons, of the barrier.

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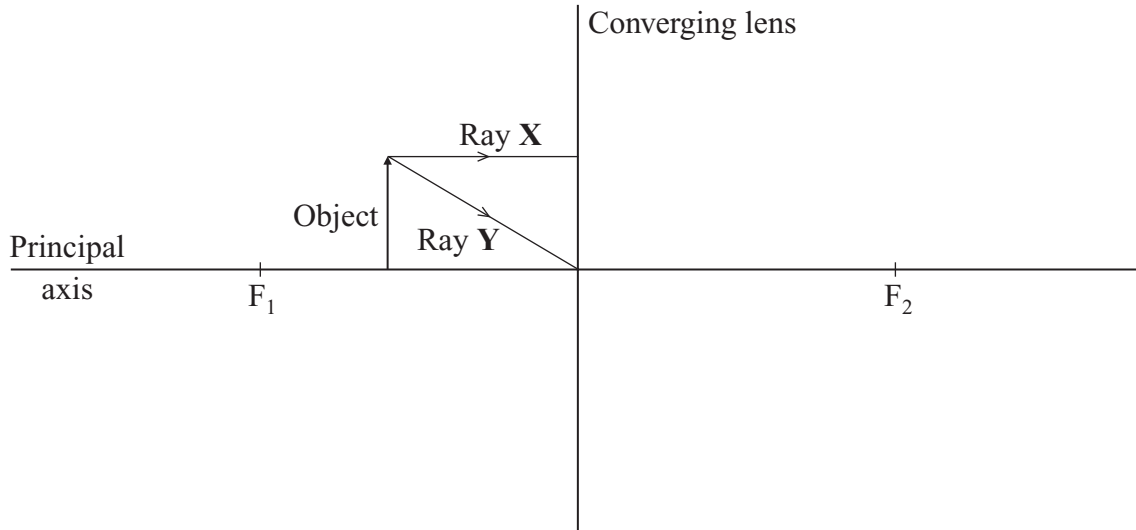
.....

Weight = ..... N  
(4 marks)

4
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**QUESTIONS RELATING TO PREVIOUSLY TESTED MODULES**

- 13** The ray diagram below can be used to show how a lens acts as a magnifying glass. The ray diagram is incomplete.



- (a) Complete the ray diagram to show what happens to ray **X**, and to ray **Y**, after they pass through the lens. (2 marks)
- (b) Show how the image is formed and label it. (1 mark)
- (c) How can you tell that this is a virtual image?

.....  
 .....  
(1 mark)

**END OF QUESTIONS**

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