General Certificate of Secondary Education
January 2009

AQA

PHYSICS **PHY3H**
Unit Physics P3

H

Higher Tier

Monday 19 January 2009   9.00 am to 9.45 am

Time allowed: 45 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Answers written in margins or on blank pages will not be marked.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The maximum mark for this paper is 45.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Advice
- In all calculations, show clearly how you work out your answer.

Answer all questions in the spaces provided.

1 (a) This information is from a science magazine.

> Electronic systems can be used to produce ultrasonic waves.
> These waves have a frequency higher than the upper limit for hearing in humans.

Complete the sentence by choosing the correct number from the box.

20	2000	20 000	200 000

The upper limit for hearing in humans is a frequency of .... Hz.

(1 mark)

1 (b) An electronic system produces ultrasound with a frequency of 500 kHz.

What does the symbol kHz stand for?

....

(1 mark)

1 (c) (i) State **one** industrial use for ultrasound.

....

(1 mark)

1 (c) (ii) State **one** medical use for ultrasound.

....

(1 mark)

1 (d) An ultrasound detector is connected to an oscilloscope.

The diagram shows centimetre squares on an oscilloscope screen.
Each horizontal division represents 2 microseconds.
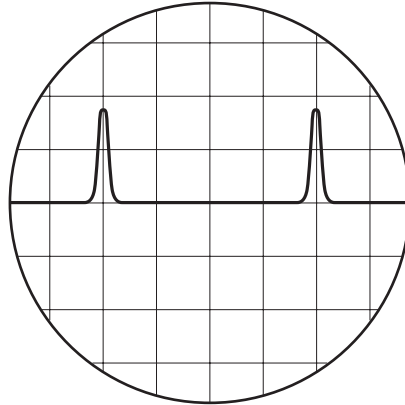
Calculate the time, in microseconds, between one peak of one ultrasound pulse and the peak of the next.

....

Time = ... microseconds
(1 mark)

1 (e) Ultrasounds are partially reflected when they reach a boundary between two different media.
The time taken for the reflection from the boundary to reach the detector can be seen from the screen.

What can be calculated from this time interval?

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(2 marks)

1 (f) Explain what action scientists should take if they find evidence that ultrasonic waves may be harmful to human health.

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(2 marks)

Turn over ▶

9

2 The diagram shows a small mobile crane. It is used on a building site.
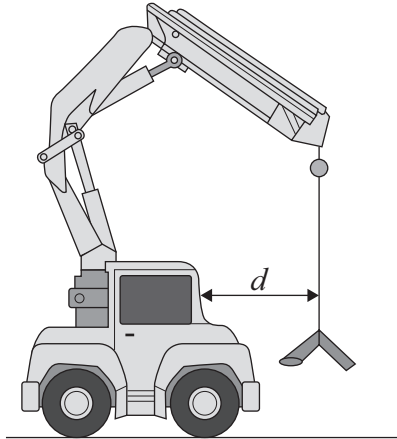
The distance, *d*, is measured to the front of the cab.

The table shows information from the crane driver's handbook.

Load in kilonewtons (kN)	Maximum safe distance, *d*, in metres (m)
10	6.0
15	4.0
24	2.5
40	1.5
60	1.0

2 (a) What is the relationship between the load and the maximum safe distance?

....

....

....

(2 marks)

2 (b) The crane driver studies the handbook and comes to the conclusion that a load of 30 kN would be safe at a distance, *d*, of 2.0 metres.

Is the driver correct?

Explain your answer.

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(2 marks)

2 (c) What is the danger if the driver does not follow the safety instructions?

....

....
(1 mark)

2 (d) How should the data in the table have been obtained?

Put a tick (✓) in the box next to your answer.

average results from an opinion poll of mobile crane drivers ☐

copied from a handbook for a similar crane ☐

results of experiments on a model mobile crane ☐
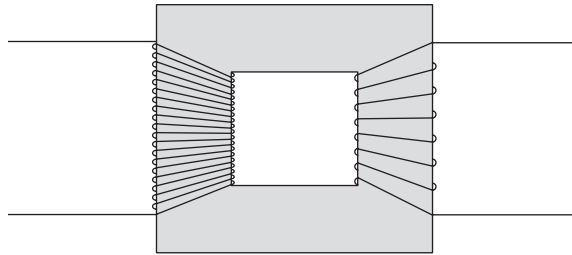
results of experiments on this mobile crane ☐
(1 mark)

6

Turn over ▶

3 **(a)** The basic structure of a transformer is a primary coil of insulated wire, an iron core and a secondary coil of insulated wire.

3 **(a)** **(i)** Why is the core made of iron?

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(1 mark)

3 **(a)** **(ii)** Explain how a transformer works.

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(4 marks)

Areas outside the box will not be scanned for marking

3 (b) A small step-down transformer is used in the charger for an electric screwdriver.

The input to the transformer is 230 V a.c. mains supply and the output is 5.75 V a.c. There are 3200 turns on the primary coil.

Use the equation in the box to calculate the number of turns on the transformer's secondary coil.

$$\frac{\text{p.d. across primary}}{\text{p.d. across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$$

Show clearly how you work out your answer.

....

....

Number of turns = ...
(2 marks)

7

Turn over for the next question

Turn over ▶

4 A student investigates the formation of images by a convex mirror.

In the mirror, she can see the image of an object placed in front of the mirror.

In the diagram, **F** is the principal focus of the mirror and **C** is the centre of curvature of the mirror.

4 (a) On the diagram, use a ruler to draw **two** rays from the top of the object which show the position of the image and how the student sees the image.

Mark the direction of the rays at each stage.
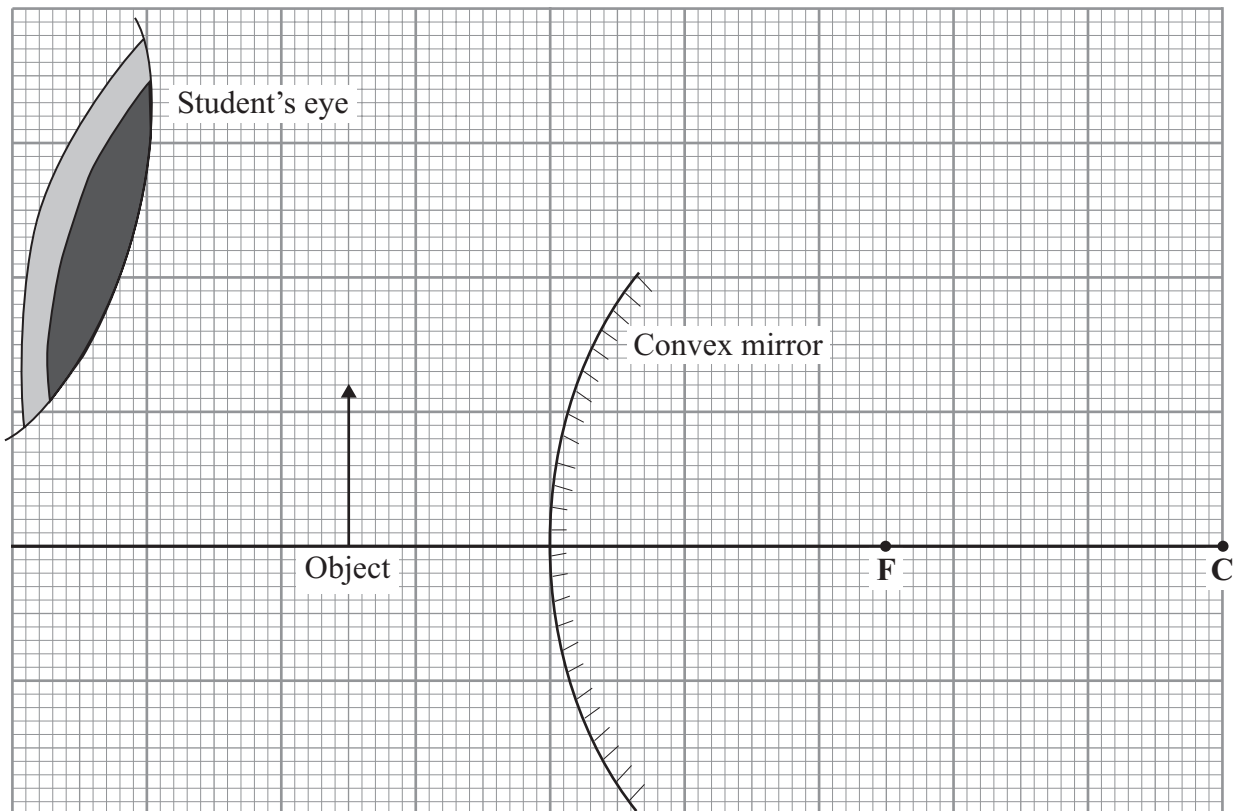
(4 marks)

4 (b) The image is a virtual image.

How can you tell from the rays you have drawn on the diagram that the image is a virtual image?

....

....

(1 mark)

5

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED**

5 The table gives data on the Solar System.

Name of planet	Average distance from the Sun in millions of kilometres	Average orbital speed in kilometres per second
Mercury	60	48
Venus	108	35
Earth	150	30
Mars	228	24
Jupiter	778	13
Saturn	1430	9.6
Uranus	2860	6.8

5 (a) A student studies this data and comes to the following conclusion.

> For the planets in the table, the average orbital speed is very nearly inversely proportional to the planet's average distance from the Sun.

5 (a) (i) This conclusion is **not** correct.

Use the data for Saturn and Uranus to explain how the student's conclusion is not correct.

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(2 marks)

5 **(a)** **(ii)** For all the listed planets, write a correct conclusion for the connection between the average distance from the Sun and the orbital speed.

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(2 marks)

5 **(b)** The student knows the following:

| The planets all move in ellipses (slightly squashed circles). |

What is the connection between this statement and the headings in the table?

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(2 marks)

6

Turn over for the next question

Turn over ▶

6 This page is from a science magazine.

The Red Planet

The two natural satellites, or moons, of Mars are Phobos (fear) and Deimos (terror). They are named after the horses which pulled the chariot of Mars, the god of war in the mythology of Ancient Greece.

Phobos takes less than eight hours to orbit Mars and gets slightly closer every time it does so. Scientists predict that in about 100 million years time it will either be ripped apart by the gravitational force or will crash onto the surface of Mars.

⦿ Deimos

⦿ Phobos
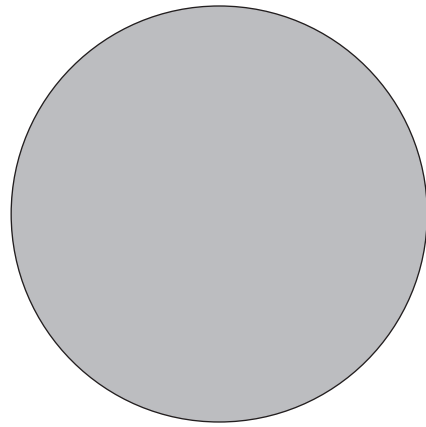
Not to scale

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6 (a) Suggest how scientists have arrived at their prediction of about 100 million years.

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(2 marks)

6 (b) The centripetal force on Phobos is gradually changing as it orbits Mars.

Is the force increasing or decreasing?

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Explain your answer.

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(2 marks)

6 (c) Scientists expect that the mass of Mars and the mass of Phobos will not increase.

Explain what will happen to the gravitational force on Phobos as it orbits Mars.

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(2 marks)

Turn over for the next question

6

Turn over ▶

7 Read this statement from a website.

> Immediately after the 'big bang', at the start of the Universe, there were only atoms of the element hydrogen (H).
>
> Now the Universe contains atoms of over one hundred elements.

7 (a) Explain how atoms of the element helium (He) are formed in a star.

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(2 marks)

7 (b) Explain how atoms of very heavy elements, such as gold (Au), were formed.

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(2 marks)

7 (c) Explain how, and when, atoms of different elements may be distributed throughout the Universe.

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(2 marks)

6

END OF QUESTIONS

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