AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

# GCSE PHYSICS

**H**

Higher Tier Unit Physics P3

Friday 16 June 2017 Morning Time allowed: 1 hour

**Materials**
For this paper you must have:
- a ruler
- a calculator
- the Physics Equations Sheet (enclosed).

**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. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

**Information**
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 2(b) should be answered in continuous prose. In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

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

| For Examiner's Use | |
|---|---|
| Examiner's Initials | |
| Question | Mark |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| TOTAL | |

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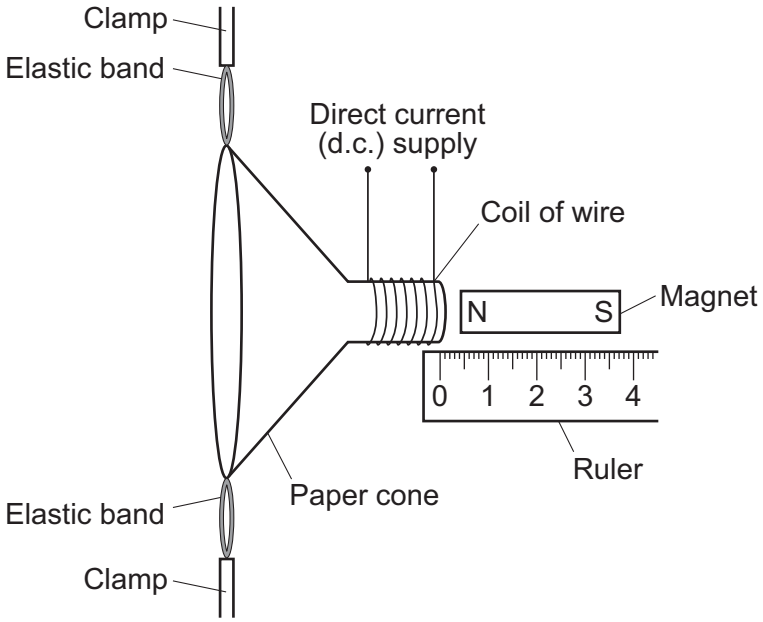
Answer **all** questions in the spaces provided.

**1** **Figure 1** shows a loudspeaker made by a student. When there is a current in the coil the paper cone moves.

**Figure 1**




The student investigates how changing the size of the current in the coil of wire affects the distance moved by the paper cone.

**1 (a)** State **two** variables the student should control.

**[2 marks]**

1 _____

_____

2 _____

_____

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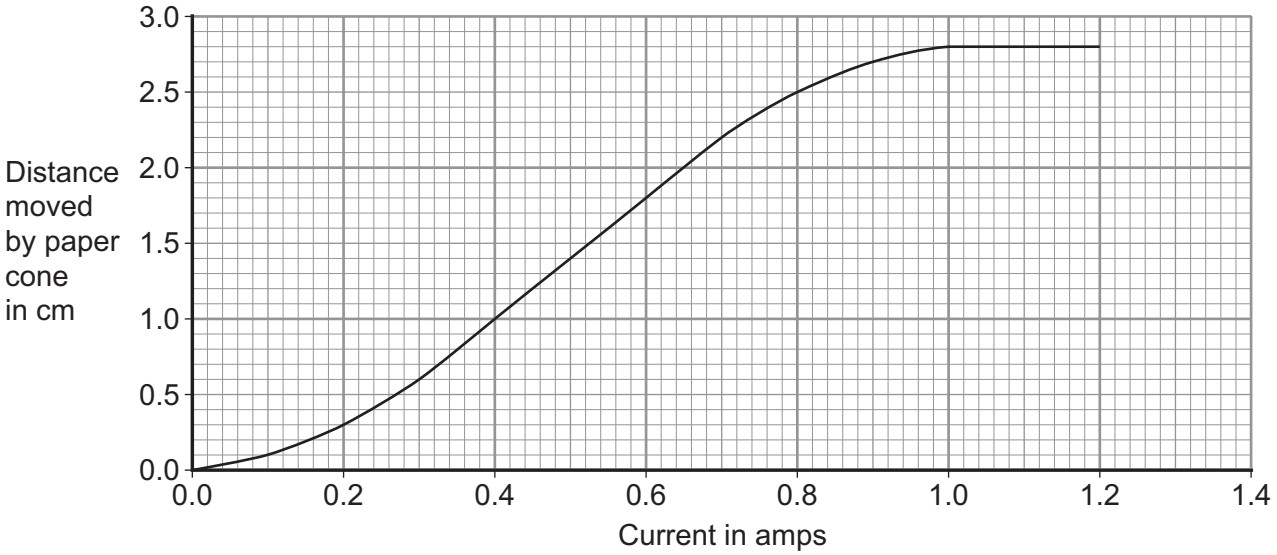
**1 (b)** The results of the student's investigation are shown in **Figure 2**.

**Figure 2**




**1 (b) (i)** When the current increases from 0.5 A to 0.9 A, how much does the distance moved increase?

**[2 marks]**

Increase in distance moved = _____ cm

**1 (b) (ii)** State **two** conclusions that can be made from the graph.

**[2 marks]**

1 _____

_____

2 _____

_____

6

**Turn over ▶**

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**2 (a)** Glasses may be used to correct defects of vision. Some glasses have been designed with lenses that can be adjusted to give different focal lengths.

Suggest **one** advantage of using adjustable lenses in glasses.

**[1 mark]**

**2 (b)** **In this question you will gain marks for using good English, organising information clearly and using scientific words correctly.**

Explain how the human eye forms an image.

Your explanation should include:

- how a normal eye causes light from objects at different distances to form an image
- why long sight and short sight cause blurred images.

Do **not** include diagrams in your answer.

**[6 marks]**

Extra space

*Do not write outside the box*

7

**Turn over for the next question**

*Do not write outside the box*

**3** CT scans are used by doctors to create three-dimensional images of a patient's body.

**3 (a) (i)** Explain why CT scans can increase the risk of cancer to the patient.

**[2 marks]**

**3 (a) (ii)** Although CT scans increase the risk of cancer they are still carried out.

Suggest why.

**[1 mark]**

**3 (b)** A child has a CT scan. Her mother stays in the room with her during the scan.

Suggest **one** precaution that the mother should take during the scan.

**[1 mark]**

**3 (c)** Ultrasound can also be used to create three-dimensional images of a patient.

State **one** advantage of using CT scans rather than ultrasound scans.

**[1 mark]**

**5**

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**4** One type of digital camera contains both a converging (convex) lens and a diverging (concave) lens.

**4 (a)** State the name of the light detector used in digital cameras.

**[1 mark]**

_____

**4 (b)** Converging and diverging lenses both produce images.

What type of images can be produced using converging and diverging lenses?

Tick (✓) **one** box for **each** type of lens.

**[2 marks]**

**Converging lens**

Real image only ☐

Virtual image only ☐

Both real and virtual images ☐

**Diverging lens**

Real image only ☐

Virtual image only ☐

Both real and virtual images ☐

**Question 4 continues on the next page**

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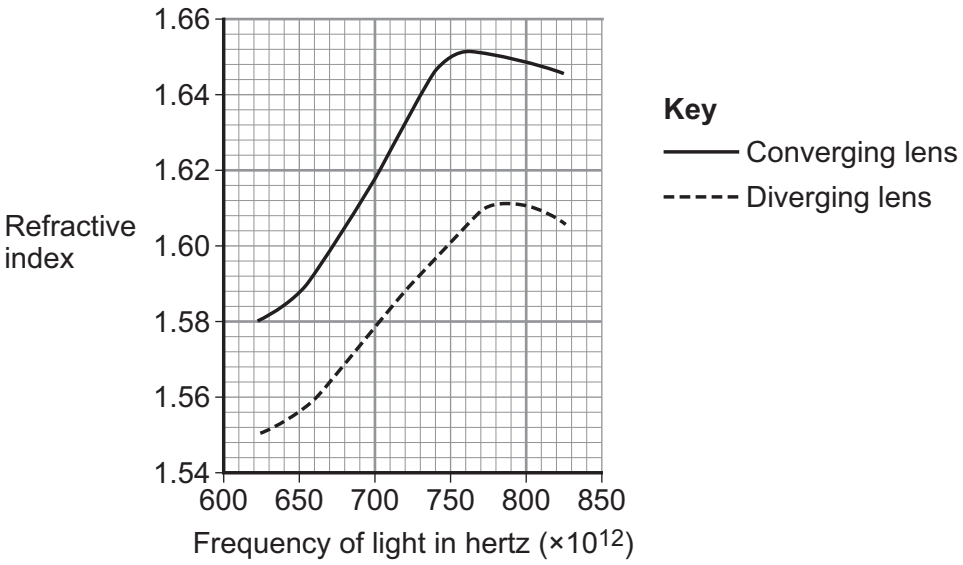
**4 (c)** Each lens in the digital camera is made from a different type of glass.

**Figure 3** shows the relationship between the frequency of light and the refractive index of the glass used to make each lens.

**Figure 3**




Describe **three differences** between the refractive index of the glass used for the converging lens compared to the glass used for the diverging lens as the frequency of light increases.

**[3 marks]**

1 _____

_____

_____

2 _____

_____

_____

3 _____

_____

_____

*Do not write outside the box*

**4 (d)** At one frequency, the glass of the diverging lens has a refractive index of 1.60
The angle of incidence of a ray of this light on the diverging lens is 20°

Calculate the angle of refraction for the ray of light.

Use the correct equation from the Physics Equations Sheet.

**[3 marks]**

Angle of refraction = _____ degrees

**4 (e)** The focal length of the diverging lens is 40 cm.

Calculate the power of the diverging lens. Give the unit.

Use the correct equation from the Physics Equations Sheet.

**[3 marks]**

Power = _____ unit _____

**4 (f)** Give **two** factors that affect the power of a lens.

**[2 marks]**

1 _____

_____

2 _____

_____

14

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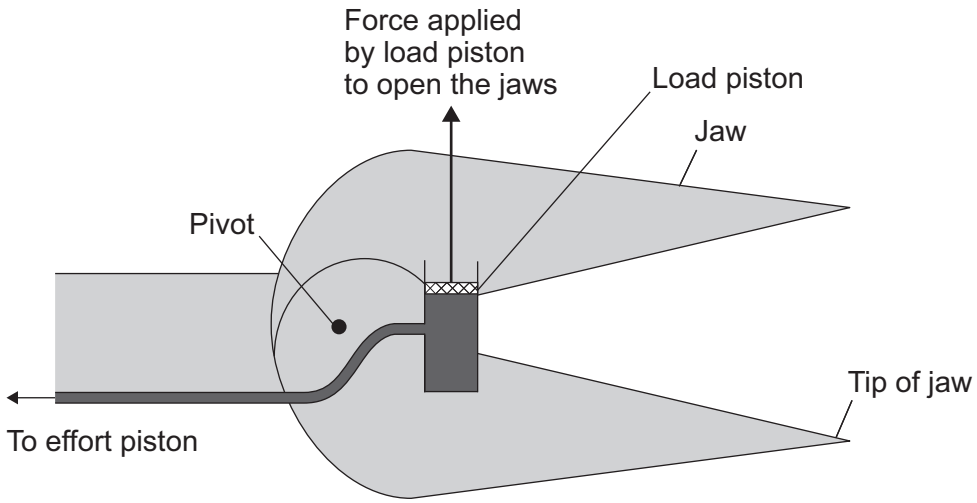
**5** **Figure 4** shows some jaws used by the fire service. The jaws are opened and closed by a hydraulic system.

**Figure 4**




**5 (a)** The force applied at the effort piston is transmitted throughout the hydraulic system.

State the property of the liquid in the hydraulic system that allows this to happen.

**[1 mark]**

_____

**5 (b)** The pressure in the liquid in the hydraulic system in the jaws is $5.2 \times 10^8$ Pa
The cross-sectional area of the load piston in the jaws is $4.1 \times 10^{-4}$ $m^2$

Calculate the force at the load piston.

Use the correct equation from the Physics Equations Sheet.

Give your answer to two significant figures.

**[3 marks]**

_____

_____

_____

_____

Force = _____ newtons

*Do not write outside the box*

**5 (c)** How does the maximum force that the tip of the jaws can apply compare to the maximum force the load piston can apply?

Give a reason for your answer.

**[2 marks]**

**5 (d)** In **Figure 4** the moments of the forces on the jaws are in equilibrium.

Explain what is meant by the statement 'the moments of the forces on the jaws are in equilibrium'.

**[2 marks]**

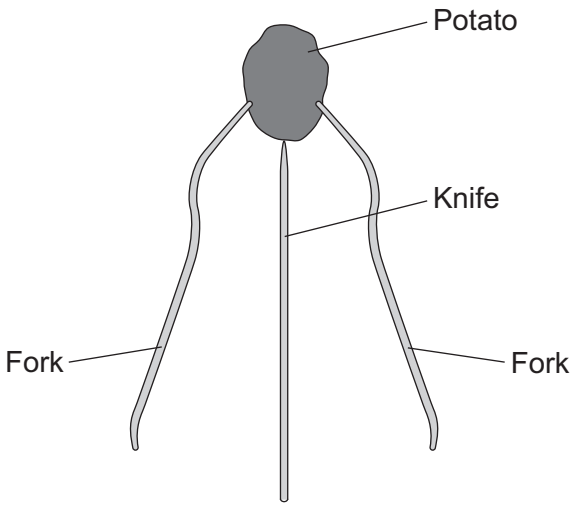
8

**Turn over for the next question**

*Do not write outside the box*

**6** **Figure 5** shows how two forks can be used to make a potato balance on the end of a knife.

**Figure 5**




**6 (a) (i)** Use a cross to mark the centre of mass of the arrangement in **Figure 5**.

**[1 mark]**

**6 (a) (ii)** State the meaning of the term 'centre of mass'.

**[1 mark]**

_____

_____

*Do not write outside the box*

**6 (b)** The potato is tilted to one side and then released. The potato and forks then oscillate from side to side.

The time taken for half an oscillation is 0.4 seconds.

Calculate the frequency of the oscillations.

Use the correct equation from the Physics Equations Sheet.

**[2 marks]**

_____

_____

_____

Frequency = _____ Hz

4

**Turn over for the next question**

Do not write outside the box

**7** Ultrasound has industrial applications as well as medical applications.

One industrial application of ultrasound is testing an aeroplane wing to make sure that there are no cracks.

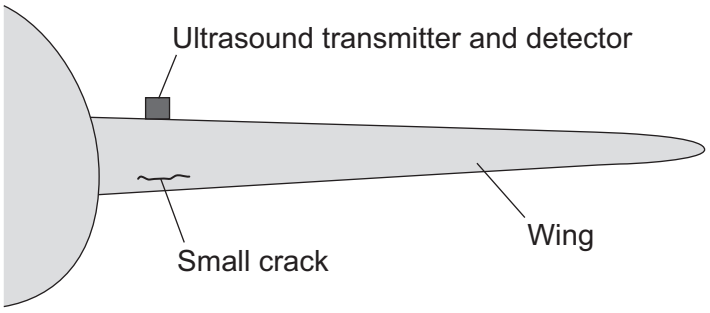
**7 (a)** State the minimum frequency of an ultrasound wave.

Include the correct unit.

**[1 mark]**

**7 (b)** An ultrasound pulse is transmitted from the top of a wing as shown in **Figure 6**.

**Figure 6**




There is a small crack in the wing. The ultrasound can be used to detect how far the crack is from the surface of the wing.

**7 (b) (i)** The ultrasound signal on its own does not directly give the distance to the crack.

What measurement is taken to determine the distance to the crack?

**[1 mark]**

**7 (b) (ii)** What other information is needed to calculate the distance from the surface of the wing to the crack?

**[1 mark]**

*Do not write outside the box*

**7 (b) (iii)** Describe what happens to the ultrasound pulse when it reaches the small crack.

**[2 marks]**

**7 (c)** An aircraft is safe to fly for at least 2000 hours after a crack begins to develop in a wing. The wing is tested after every 500 hours of flying time. If a crack is found the wing is replaced immediately.

If there is a crack in the wing, an ultrasound test will detect the crack 99% of the time.

Suggest why the interval between tests is less than the safe flying time after a crack develops.

**[1 mark]**

6

**Turn over for the next question**

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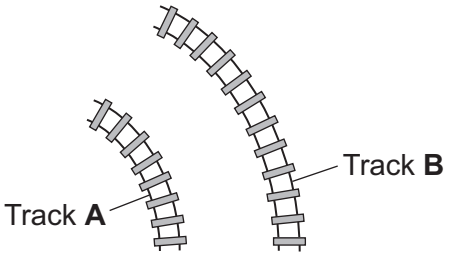
**8** **Figure 7** shows two train tracks, **A** and **B**.

**Figure 7**




**8 (a) (i)** A train moves at constant speed along track **A**.

Explain how the train can be accelerating while travelling at a constant speed.

**[3 marks]**

**8 (a) (ii)** Two identical trains travel on the tracks, one on track **A** and one on track **B**.

Explain which train can travel at the highest maximum speed.

**[2 marks]**

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**8 (b)** One type of train is designed to tilt as it goes around bends. Tilting the train more increases the centripetal force that acts on the train.

**8 (b) (i)** Suggest **one** advantage of creating a train which can vary the amount it tilts as it goes around bends.

**[1 mark]**

_____

_____

**8 (b) (ii)** The tilting train is designed so that the line of action of the weight of the train always lies between the two rails.

State why the train does not topple.

**[1 mark]**

_____

_____

**Question 8 continues on the next page**

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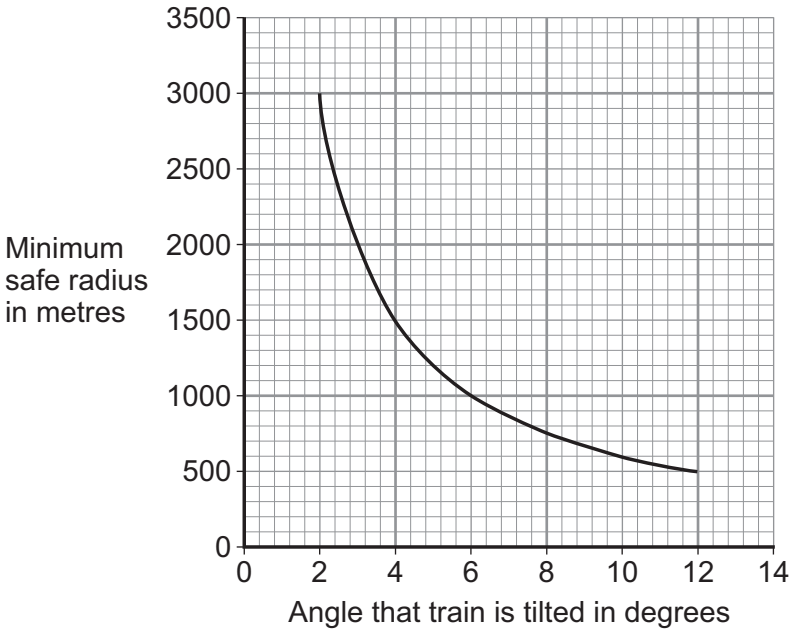
**8 (c)** An engineer built a small scale model to predict the minimum safe radius of curved track that the tilted train could safely go round at 250 km/hour. The results predicted using the small scale model are shown in **Figure 8**.

**Figure 8**




**8 (c) (i)** The engineer described the relationship between the angle that the train tilted and the minimum safe radius at 250 km/hour as inversely proportional.

Use data from the graph to explain why the engineer is correct.

**[2 marks]**

**8 (c) (ii)** The engineer also created a computer simulation of the tilting train.

Suggest **one** benefit of using a computer simulation over using a small scale model.

**[1 mark]**

10

**END OF QUESTIONS**

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