

Centre Number						Candidate Number				
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Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
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8	
TOTAL	



General Certificate of Secondary Education
Higher Tier
June 2014

Further Additional Science Unit 3 Physics P3

FAS3HP

H

Monday 19 May 2014 1.30 pm to 2.30 pm

For this paper you must have:

- a ruler
- a calculator
- the Physics Equations Sheet (enclosed).

Time allowed

- 1 hour

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 3(a) 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.



J U N 1 4 F A S 3 H P 0 1

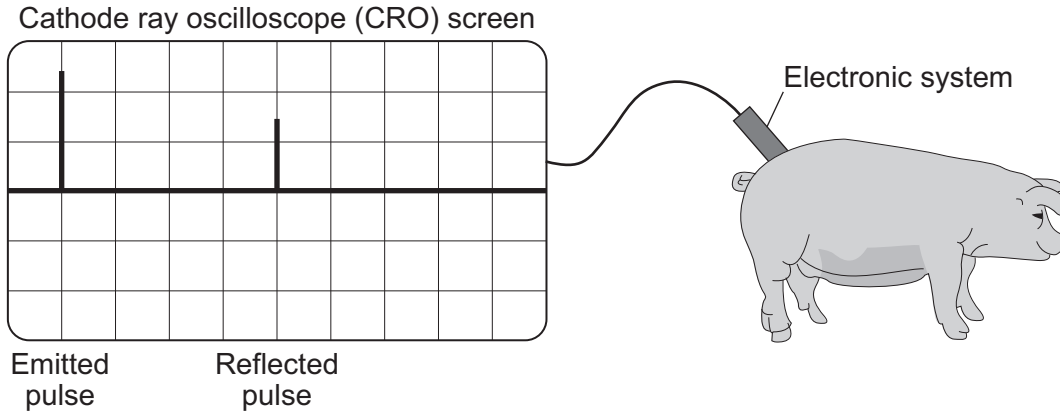
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FAS3HP

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

- 1 (a)** **Figure 1** shows how ultrasound can be used to measure the thickness of an animal's layer of fat.

Figure 1



1 horizontal division = 0.00001 seconds

A pulse of ultrasound is sent out from the electronic system. The emitted pulse and the pulse reflected from the bottom of the layer of fat are detected and shown on the screen of the CRO.

- 1 (a) (i)** How long did it take for the emitted ultrasound pulse to be received back at the electronic system?

[1 mark]

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Time = seconds

- 1 (a) (ii)** The speed of ultrasound in fat is 1500 metres per second.

Calculate the thickness of the animal's layer of fat.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

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Thickness of layer of fat = metres



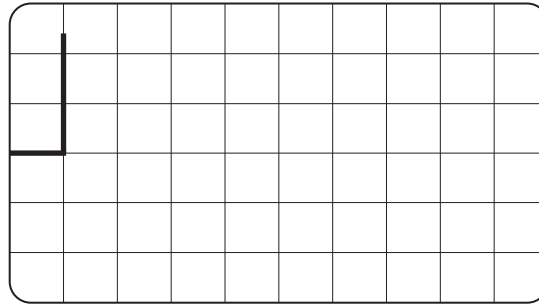
1 (a) (iii) The layer of fat of a second animal is measured.

This layer of fat is half the thickness of the layer of fat of the first animal.

On **Figure 2**, draw the ultrasound trace for the second animal.

[1 mark]

Figure 2



Emitted pulse

1 (b) Ultrasound scanning or Computerised Tomography (CT) scanning can be used to make images of the inside of the human body.

A CT scanner uses X-rays to produce these images.

State **one** advantage and **one** disadvantage of using ultrasound scanning, compared with CT scanning, for imaging the inside of the human body.

[2 marks]

Advantage of ultrasound scanning

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Disadvantage of ultrasound scanning

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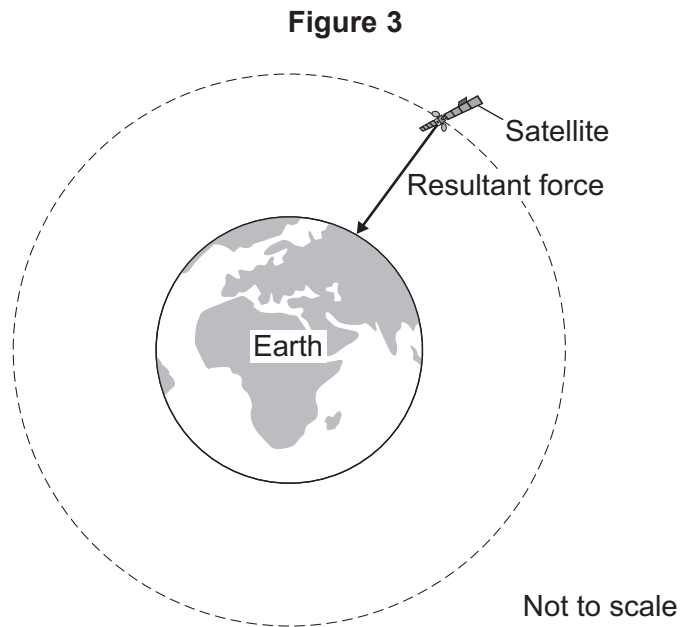
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- 2 Man-made satellites can orbit the Earth, as shown in **Figure 3**.



The satellite experiences a resultant force directed towards the centre of the orbit.

The resultant force is called the centripetal force.

- 2 (a) What provides the centripetal force on the satellite?

[1 mark]

.....

- 2 (b) State **two** factors that determine the size of the centripetal force on the satellite.

[2 marks]

1

2



2 (c) Table 1 gives data for five different satellites orbiting the Earth.

Table 1

Satellite	Average height above Earth's surface in kilometres	Time taken to orbit Earth once in minutes	Mass of satellite in kilograms
A	370	93	419 000
B	697	99	280
C	827	103	630
D	5 900	228	400
E	35 800	1440	2 030

2 (c) (i) State the relationship, if any, between the height of the satellite above the Earth's surface and the time taken for the satellite to orbit the Earth once.

[1 mark]

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2 (c) (ii) State the relationship, if any, between the time taken for the satellite to orbit the Earth once and the satellite's mass.

[1 mark]

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Question 2 continues on the next page

Turn over ►



2 (d) Over 300 years ago, the famous scientist Isaac Newton proposed, with a 'thought experiment', the idea of satellites.

Newton suggested that if an object was fired at the right speed from the top of a high mountain, it would circle the Earth.

Why did many people accept Isaac Newton's idea as being possible?

Tick (✓) **one** box.

[1 mark]

Isaac Newton was a respected scientist who had made new discoveries before.

Isaac Newton went to university.

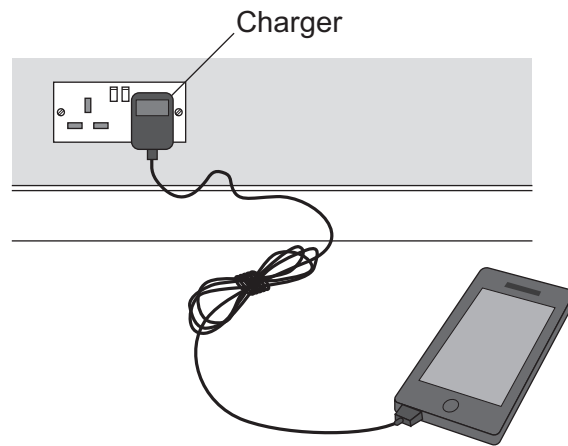
It was a new idea that nobody else had thought of before.

6



3 (b) Figure 4 shows a mobile phone and charger.

Figure 4



Mobile phone chargers use a different type of transformer, which is smaller and lighter than a traditional transformer.

What name is given to the type of transformer used in a mobile phone charger?

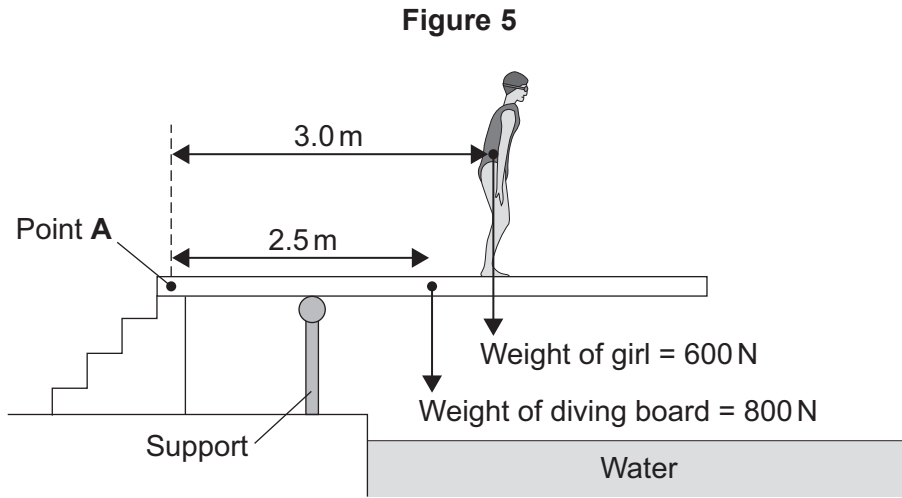
[1 mark]

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4 (a) Figure 5 shows a girl standing on a diving board.



Calculate the total clockwise moment of the weight of the diving board and the weight of the girl about Point A. Give the unit.

Use the correct equation from the Physics Equations Sheet.

[4 marks]

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Total clockwise moment about Point A =

Question 4 continues on the next page

Turn over ▶



- 4 (b) **Figure 6** shows the girl standing at a different place on the diving board.
The support provides an upward force F to keep the diving board balanced.

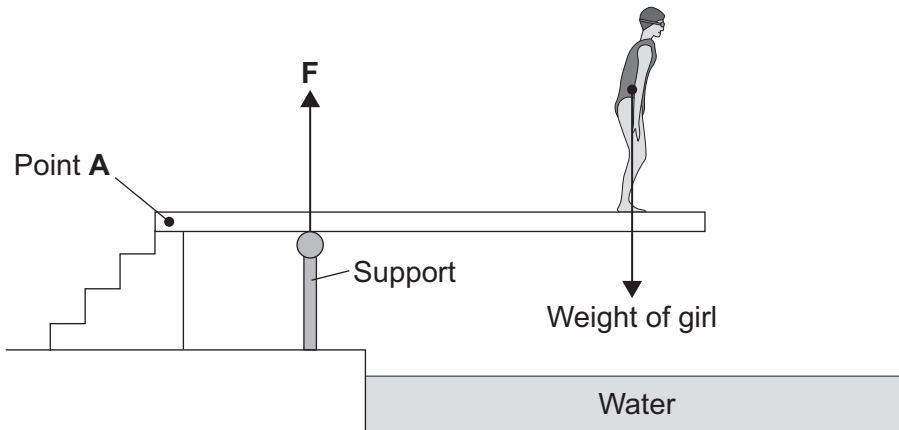
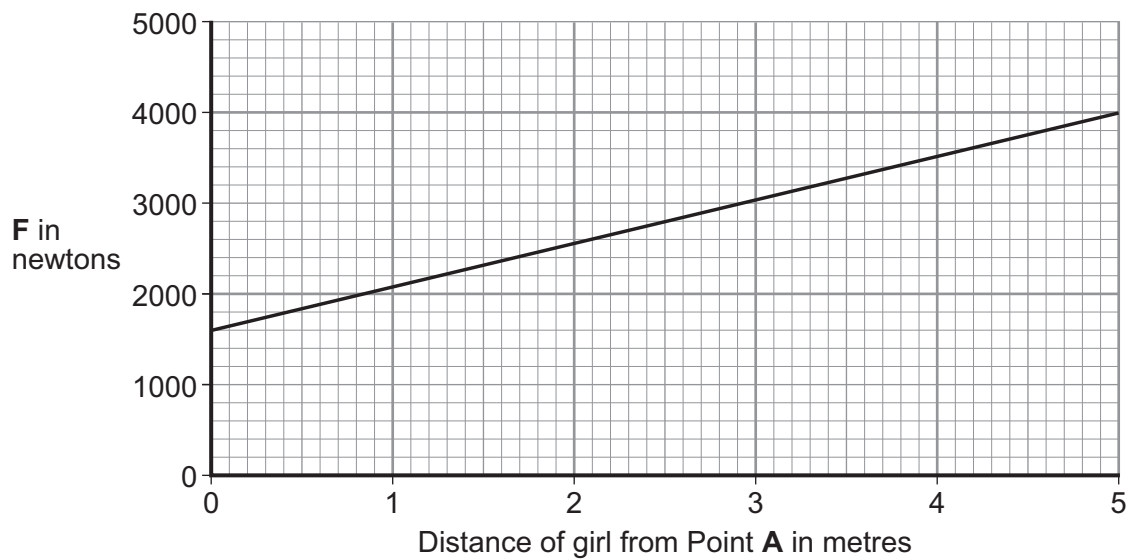
Figure 6

Figure 7 shows how the upward force F varies with the distance of the girl from Point A.

Figure 7

Explain, in terms of clockwise and anticlockwise moments, why the upward force **F** increases as shown in **Figure 7**.

[3 marks]

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Turn over for the next question

Turn over ►



5 (a) Digital cameras use converging (convex) lenses to produce images.

The power of a lens in a digital camera is + 6.25 dioptres.

Calculate the focal length of this lens.

Use the correct equation from the Physics Equations Sheet.

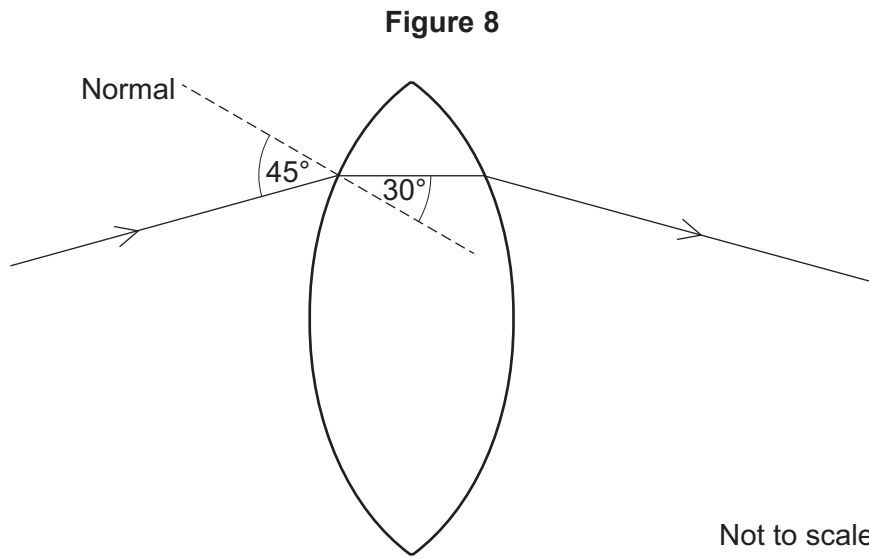
[2 marks]

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Focal length of lens = metres



5 (b) Figure 8 shows a ray of light passing through a converging (convex) lens.



Use the information in **Figure 8** to calculate the refractive index of the glass used to make the lens.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

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Refractive index =

5 (c) The refractive index of the material used to make a lens affects its focal length.

State **one** other factor that affects the focal length of a lens.

[1 mark]

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Question 5 continues on the next page

Turn over ►



5 (d) Converging (convex) lenses can be used to correct a defect of vision of the human eye.
What defect of vision can a converging lens correct? **[1 mark]**

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5 (e) Digital cameras and human eyes both contain lenses.
They both have other parts with the same function.
Complete the missing parts in **Table 2**. **[2 marks]**

Table 2

Details of part	Part of eye	Part of digital camera
Refracts light to produce an image	Cornea and lens	Lens
Images are focused here	CCD
Variable opening where light enters	Pupil

5 (f) CCDs (charge-coupled devices) that are used in digital cameras did not exist 50 years ago.
Suggest why further new parts for cameras may be developed in the future. **[1 mark]**

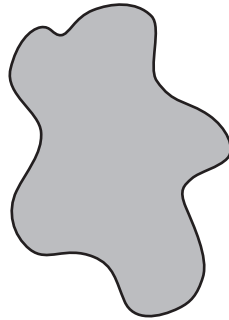
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6 (a) Figure 9 shows a sheet of card.

Figure 9



Describe how to find the centre of mass of this sheet of card.

You may draw diagrams as part of your answer.

[5 marks]

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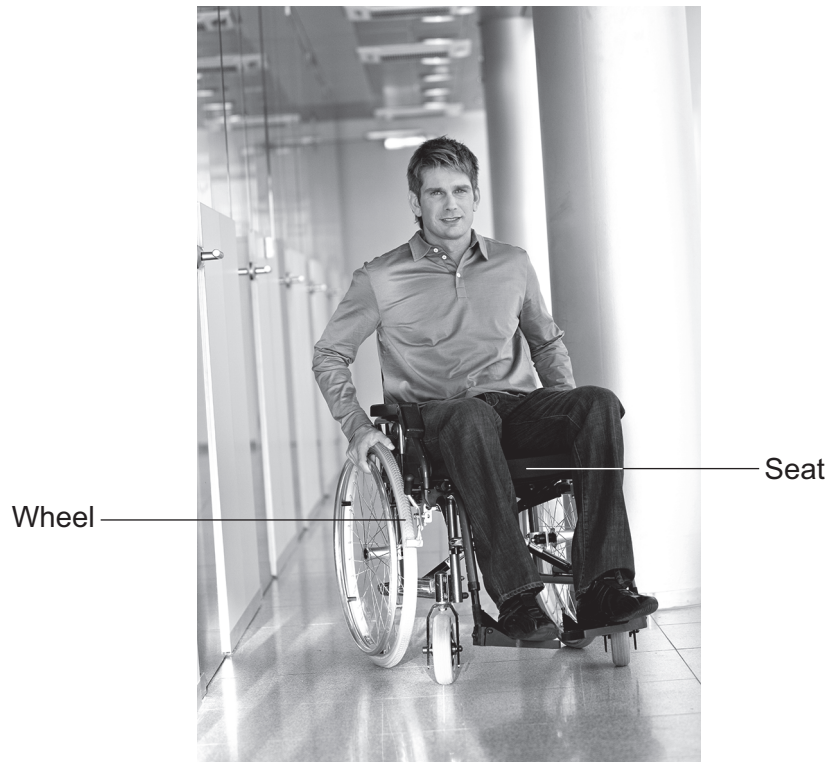
Question 6 continues on the next page

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6 (b) Figure 10 shows a person in his wheelchair.

Figure 10



6 (b) (i) Tipping the wheelchair at a large angle may cause it to become unstable and to topple over.

Explain why.

[2 marks]

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6 (b) (ii) Some disabled athletes use a wheelchair in sports.

State **two** ways of changing the design of the wheelchair in **Figure 10** so that it is more stable when used by a disabled athlete.

[2 marks]

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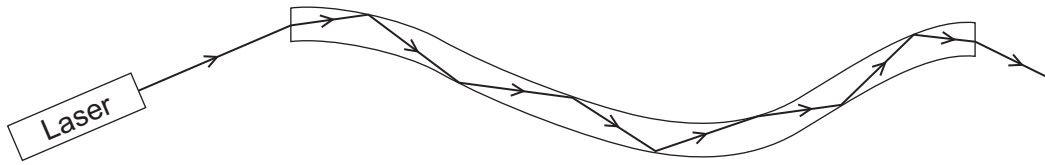
Turn over for the next question

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7 **Figure 11** shows how a ray of light from a laser travels along an optical fibre.

Figure 11



7 (a) Why does the ray of light stay within the optical fibre?

[1 mark]

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7 (b) The material used to make the optical fibre has a refractive index of 1.50.
Calculate the critical angle of this material.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

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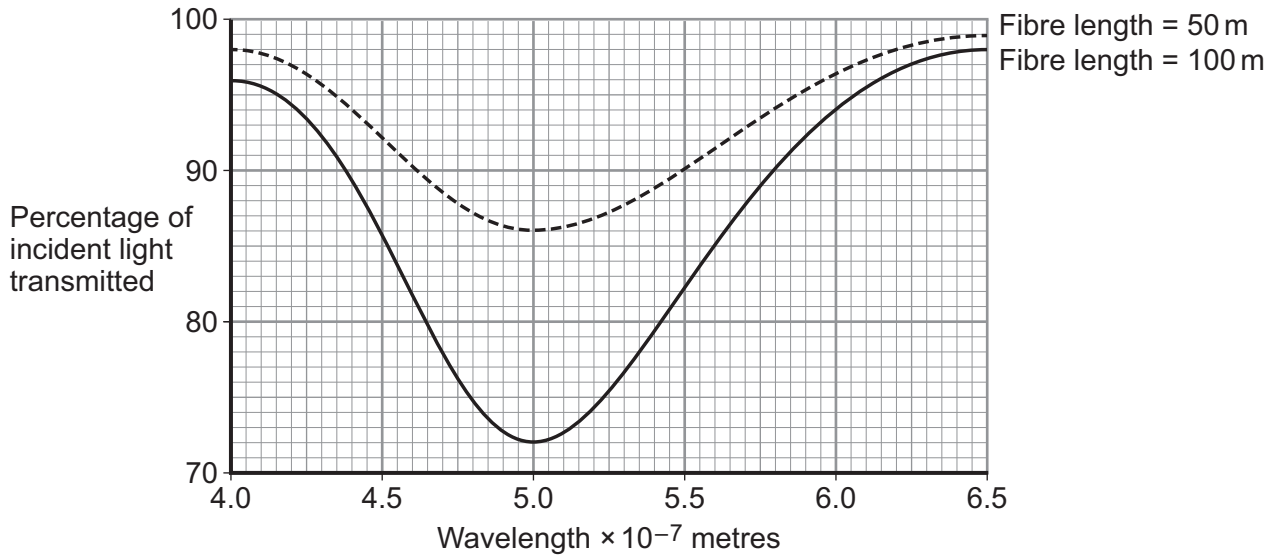
Critical angle = degrees



7 (c) Different wavelengths of light can be used to transmit information along optical fibres.

Figure 12 shows how the percentage of incident light transmitted through a fibre varies with the wavelength of light and the length of the fibre.

Figure 12



Compare the percentages of incident light transmitted through the two different fibres over the range of wavelengths shown.

[3 marks]

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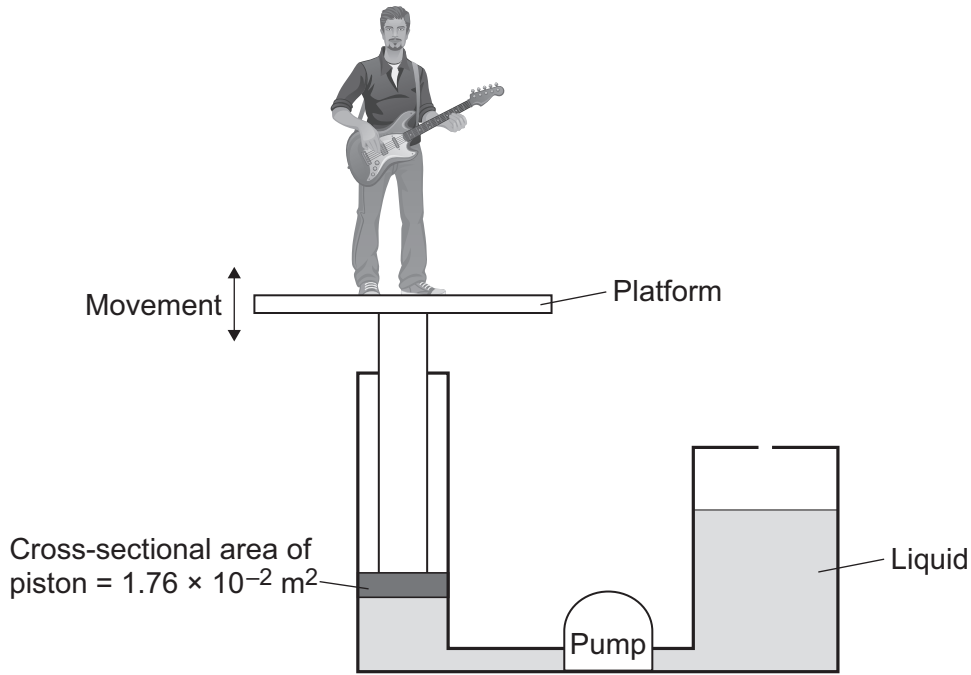
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8 Musicians sometimes perform on a moving platform.

Figure 13 shows the parts of the lifting machine used to move the platform up and down.

Figure 13



8 (a) What type of system uses a liquid to transmit a force?

[1 mark]

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8 (b) The pump creates a pressure in the liquid of $8.75 \times 10^4 \text{ Pa}$ to move the platform upwards.

Calculate the force that the liquid applies to the piston.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

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Force = N



8 (c) The liquid usually used in the machine is made by processing oil from underground wells. A new development is to use plant oil as the liquid.

Extracting plant oil requires less energy than extracting oil from underground wells.

Suggest an environmental advantage of using plant oil.

[1 mark]

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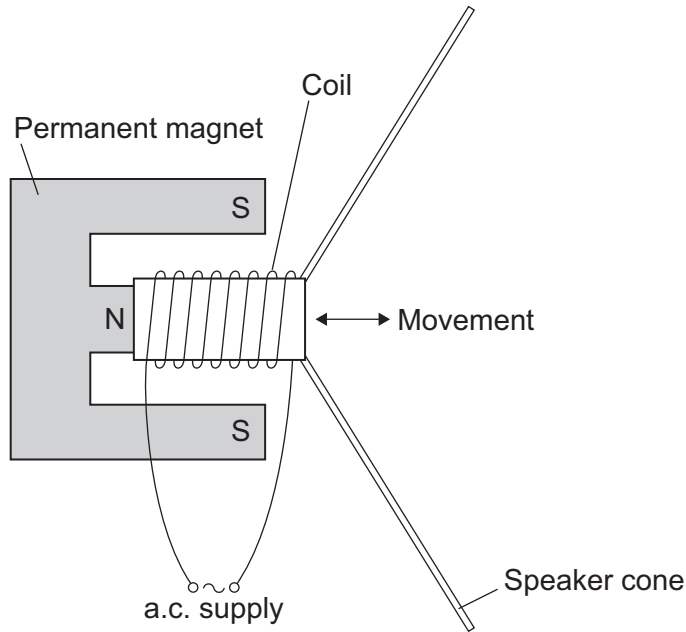
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8 (d) Musicians often use loudspeakers.

Figure 14 shows how a loudspeaker is constructed.

Figure 14



The loudspeaker cone vibrates when an alternating current flows through the coil.

Explain why.

[4 marks]

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END OF QUESTIONS



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