AQA GCSE PHYSICS (4403)

PHYSICS



EXAM QUESTION PACK

UNIT P3 HIGHER TIER PH3HP PAPERS

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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 17 June 2016 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 1(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.

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

1 (a) Electromagnets are often used at recycling centres to separate some types of metals from other materials.

Give **one** reason why an electromagnet would be used rather than a permanent magnet.

[1 mark]

_____

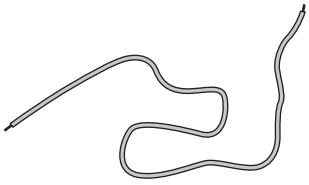
_____

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

Some students want to build an electromagnet.

The students have the equipment shown in **Figure 1**.

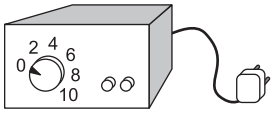
Figure 1



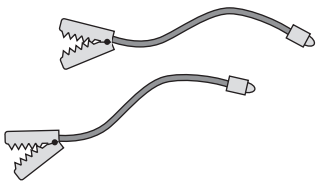
Insulated wire



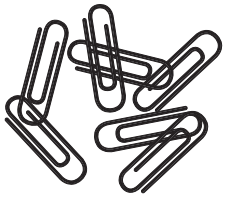
Iron nail



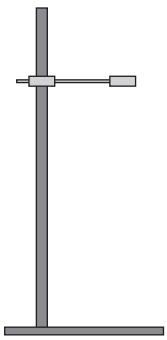
Power supply



Connecting leads



Steel paperclips



Wooden clamp and stand

Do not write outside the box

Describe how the students could build an electromagnet. Include in your answer how the students should vary and test the strength of their electromagnet.

[6 marks]

Extra space

7

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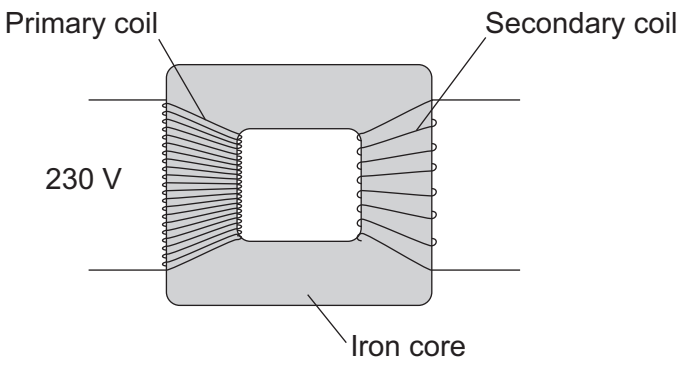
There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED

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2 **Figure 2** shows the structure of a traditional transformer.

Figure 2



2 (a) There is an alternating current in the primary coil of the transformer.

State what is produced in the iron core.

[2 marks]

_____

_____

2 (b) A transformer has only **one** turn of wire on the secondary coil.
The potential difference across the secondary coil is 11.5 V
The potential difference across the primary coil is 230 V

Calculate the number of turns on the primary coil.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

_____

_____

_____

_____

Number of turns on the primary coil = _____

Question 2 continues on the next page

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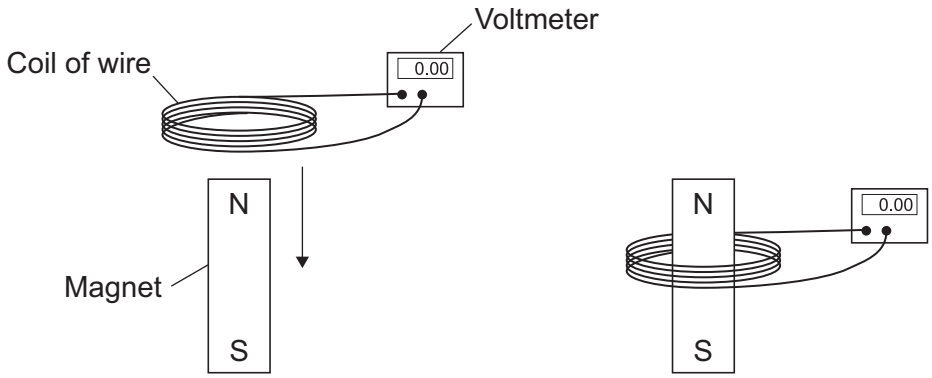
2 (c) In most transformers, the power output is less than the power input.

State why.

[1 mark]

2 (d) Two students investigated how magnets can be used to produce a potential difference. The students held a coil of wire above a magnet. The students quickly lowered the coil so that the magnet was inside the coil, as shown in **Figure 3**.

Figure 3



The students recorded the maximum potential difference for coils with different numbers of turns of wire. The results are shown in **Table 1**.

Table 1

Number of turns of wire in the coil	Maximum potential difference in volts	
	Results from student 1	Results from student 2
5	0.09	0.08
10	0.20	0.15
15	0.31	0.25
20	0.39	0.33
25	0.51	0.39

Do not write outside the box

2 (d) (i) State the resolution of the voltmeter.

Give **one** reason why the resolution of the voltmeter is suitable for this investigation.

[2 marks]

Resolution _____

Reason _____

_____

2 (d) (ii) The two students used exactly the same equipment to carry out their investigations. Both students recorded their results correctly.

Give the reason why student 2 got different results from student 1.

[1 mark]

_____

_____

2 (d) (iii) The students decided that even though the results were different, there was no need to repeat the investigation.

How do the results show that the investigation is reproducible?

[1 mark]

_____

_____

2 (d) (iv) State the name of the process which causes the potential difference to be produced in this investigation.

[1 mark]

_____

2 (e) A transformer has been developed that can be used with many different devices.

Suggest **one** advantage of having a transformer that can be used with many different devices.

[1 mark]

_____

_____

11

Do not write outside the box

3 X-rays and ultrasound can both be used for scanning internal organs.

3 (a) Ultrasound is used to scan unborn babies but X-rays are **not** used to scan unborn babies.

Explain why.

[3 marks]

3 (b) The behaviour of ultrasound waves when they meet a boundary between two different materials is used to produce an image.

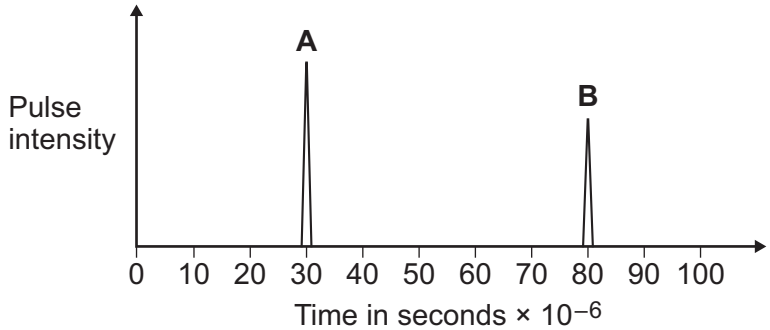
Describe how.

[2 marks]

Do not write outside the box

3 (c) **Figure 4** shows two pulses from a scan of an unborn baby. The emitted pulse is labelled **A**. The returning pulse picked up by the receiver is labelled **B**.

Figure 4



The closest distance between the unborn baby and the mother's skin is 4.0 cm.
Use information from **Figure 4** to calculate the average speed of the pulse.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Average speed = _____ m/s

Question 3 continues on the next page

Do not write outside the box

3 (d) **Figure 5** shows an X-ray of an arm with a broken bone.

Figure 5



3 (d) (i) Describe how X-rays are able to produce an image of bones.

[3 marks]

3 (d) (ii) Complete the following sentence.

X-rays are able to produce detailed images because their wavelength is very _____ .

[1 mark]

12

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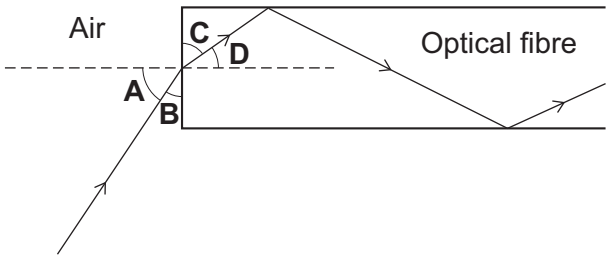
Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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4 **Figure 6** shows a ray of light going from air into an optical fibre and then travelling through part of the optical fibre.

Figure 6



4 (a) Which **one** of the following pairs of angles correctly identifies the angle of incidence and the angle of refraction?

[1 mark]

Tick (✓) **one** box.

Angle of incidence	Angle of refraction	Tick (✓)
A	C	
A	D	
B	C	
B	D	

4 (b) The glass used to make this optical fibre has a refractive index of 1.5.

Calculate the critical angle of the glass.
Give your answer to 2 significant figures.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Critical angle = _____ degrees

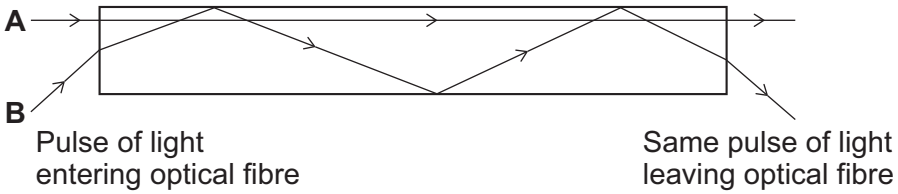
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4 (c) Short pulses of light can carry information through optical fibres.

Each pulse is made of lots of light rays. The light rays refract into the optical fibres at different angles when the pulse is sent.

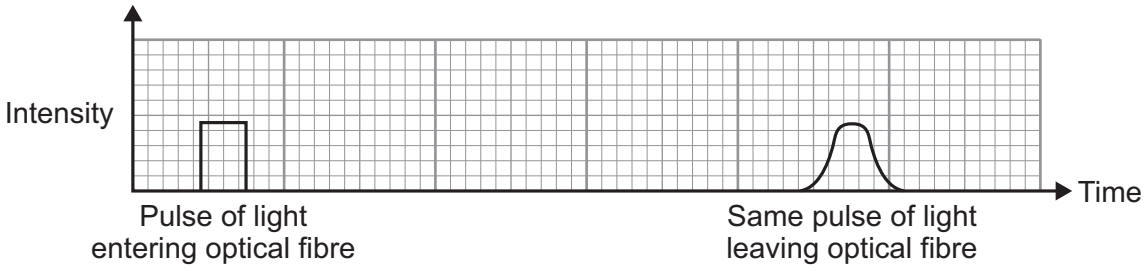
The paths of two possible rays, **A** and **B**, are shown in **Figure 7**. These rays make up part of the pulse shown in **Figure 8**.

Figure 7



A pulse of light entering the optical fibre has changed when it leaves the optical fibre, as shown in **Figure 8**.

Figure 8



By considering the paths of rays **A** and **B**, explain why the pulse of light shown in **Figure 8** changed as it passed through the optical fibre.

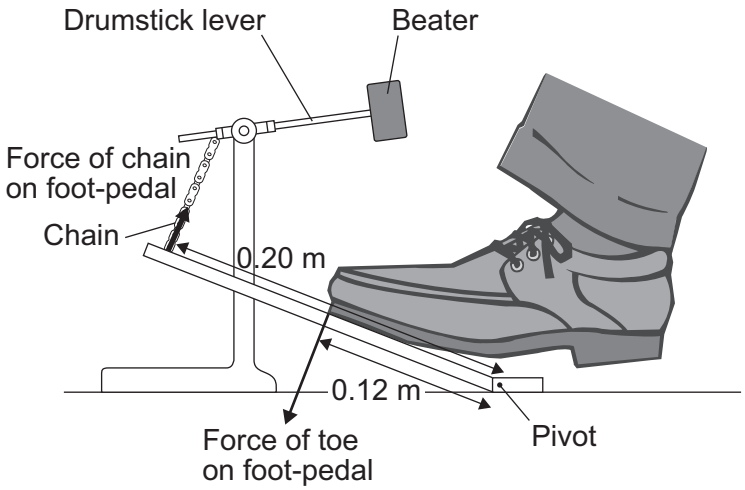
[2 marks]

6

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5 A drum is hit by a beater attached to a drumstick lever. The drumstick lever is attached to a foot-pedal by a chain, as shown in **Figure 9**.

Figure 9



5 (a) When the toe is pushed down the force creates a moment on the foot-pedal.

5 (a) (i) State what is meant by the moment of a force.

[1 mark]

5 (a) (ii) The foot-pedal is pushed halfway down and held stationary. The toe and the chain both exert a force on the foot-pedal.

Compare the sizes and directions of the moments caused by the force of the toe and the force of the chain on the foot-pedal.

[1 mark]

Do not write outside the box

5 (a) (iii) The drummer's toe pushes with a 1.5 N force on the foot-pedal.
The perpendicular distance from the pivot to the force is 0.12 m.
The perpendicular distance from the pivot to the chain is 0.20 m.

Calculate the force of the chain acting on the foot-pedal.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Force = _____ N

Question 5 continues on the next page

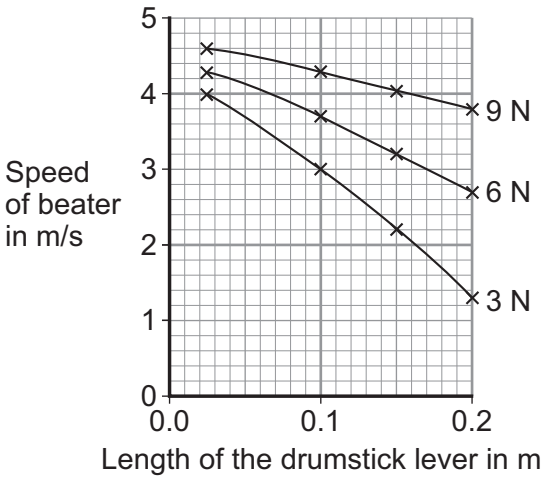
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5 (b) The foot-pedal is pushed with different forces to make the beater move at different speeds.

The higher the speed at which the beater hits the drum, the louder the sound the drum makes.

Figure 10 shows how the length of the drumstick lever affects the speed of the beater for three different forces.

Figure 10



The drummer needs to be able to sometimes play the drum quietly and sometimes loudly.

How does the **length** of the drumstick lever affect the variation in loudness of the sound from the drum when applying:

[2 marks]

a force of 3 N? _____

_____

a range of forces from 3 N to 9 N? _____

_____

7

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

6 In a balancing game, wooden blocks are used to build a tower. The shape of the tower at the start of the game is shown in **Figure 11**. During the game, some of the blocks are taken out and put on top of the tower as shown in **Figure 12**. This causes the centre of mass of the tower to change.

Figure 11

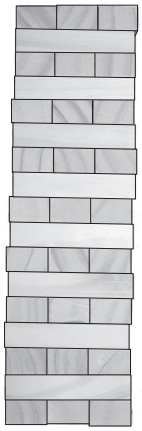
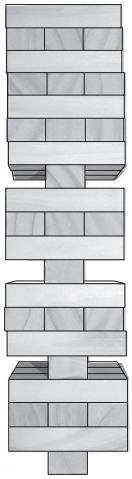


Figure 12



6 (a) (i) State what is meant by the term 'centre of mass'.

[1 mark]

_____

_____

_____

6 (a) (ii) Give **two** reasons why the tower in **Figure 12** is less stable than the tower in **Figure 11**.

[2 marks]

1 _____

_____

2 _____

_____

Do not write outside the box

6 (b) **Figure 13** shows a different arrangement for the wooden blocks.

Figure 13



A block was placed in position **A** and an identical block was placed in position **B** at the same time.

Explain why the tower did not fall over. You should include reference to moments in your answer.

[2 marks]

5

Turn over for the next question

Do not write outside the box

7 (a) Some people have an eye defect called long sight.

7 (a) (i) State **one** cause of long sight.

[1 mark]

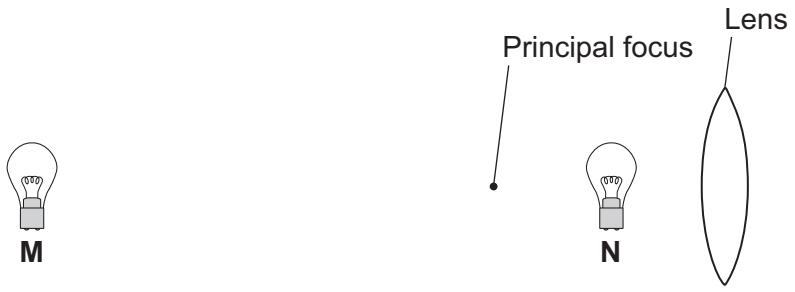
7 (a) (ii) Long sight can be corrected by surgery. During surgery, the surgeon may need to cut and heat very delicate parts of the eye.

Name the piece of equipment which provides the energy source used to do this.

[1 mark]

7 (b) A light bulb is placed between a convex lens and the principle focus of this lens, at position **N** shown in **Figure 14**. The light bulb is then moved to position **M**, a large distance from the lens.

Figure 14



Describe how the nature of the image formed changes as the light bulb is moved from position **N** to position **M**.

[3 marks]

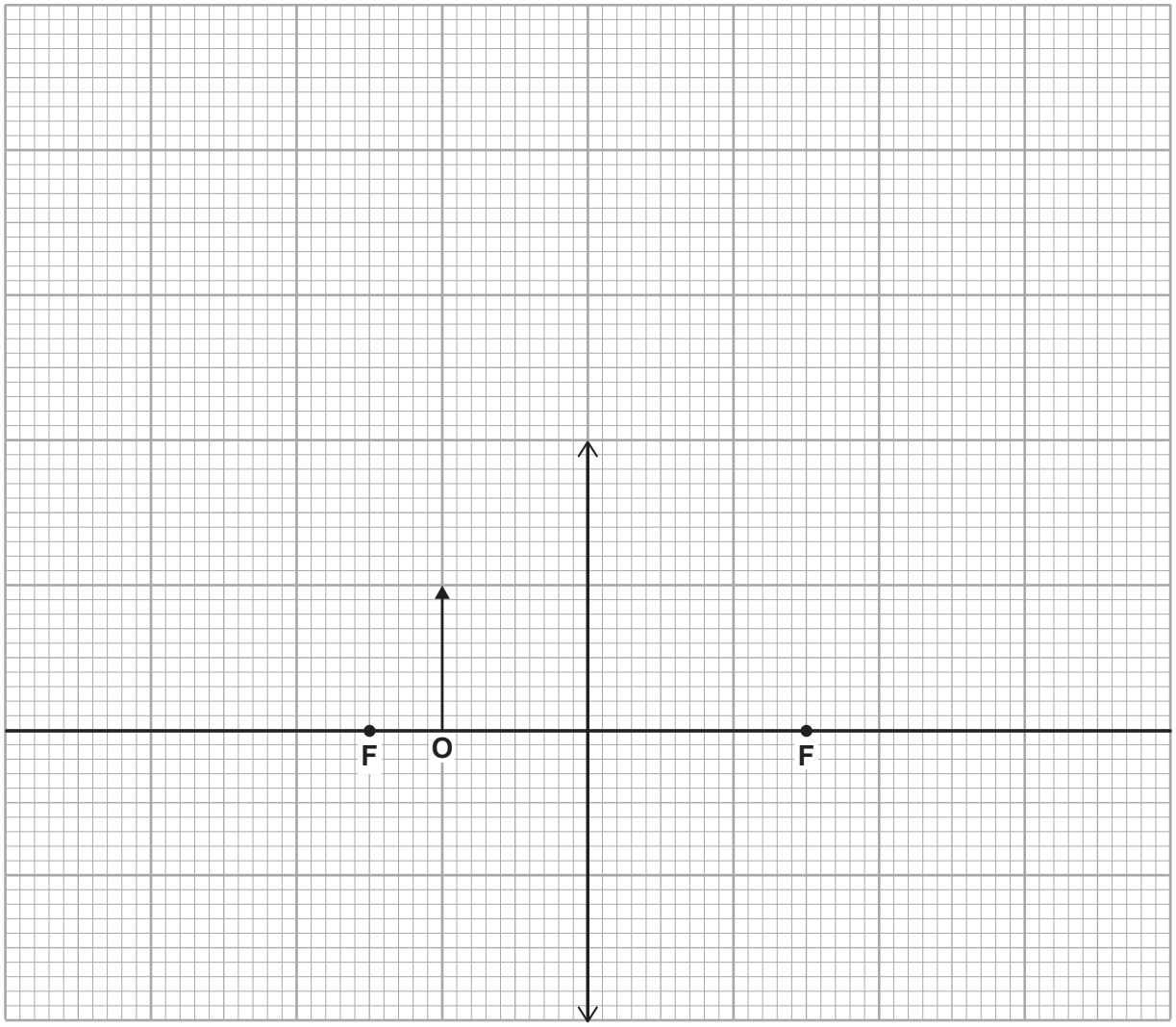
Do not write outside the box

7 (c) An object, **O**, is very near to a convex lens, as shown in **Figure 15**.

Complete **Figure 15** to show how rays of light from the object form an image.

[3 marks]

Figure 15



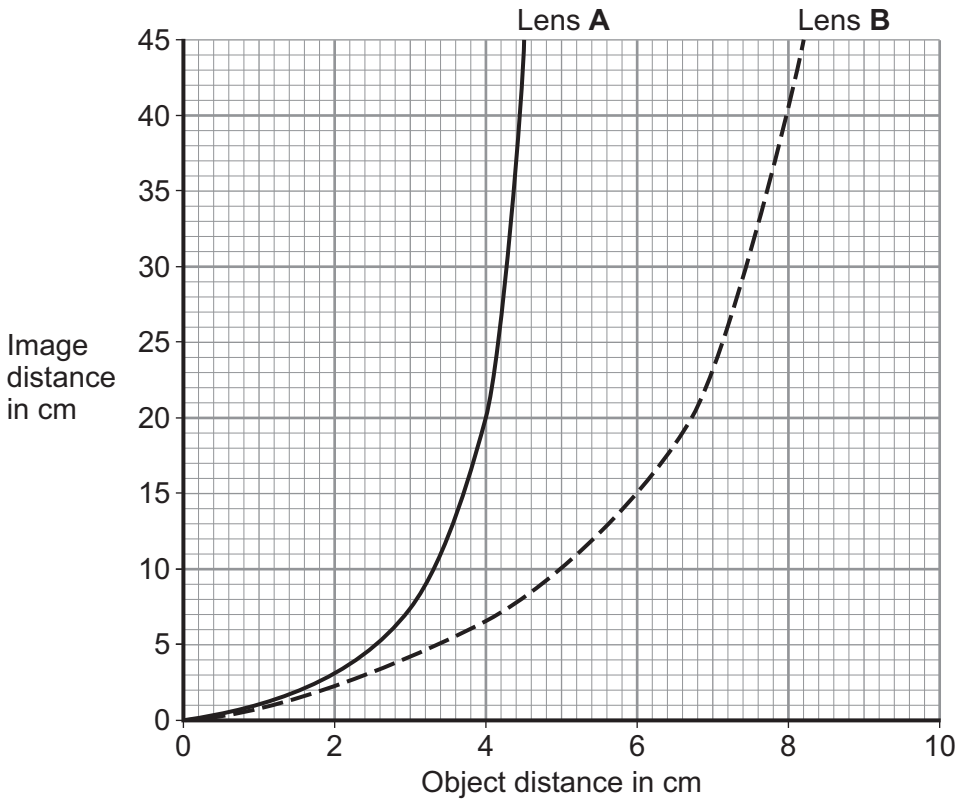
Question 7 continues on the next page

Do not write outside the box

7 (d) The object distance is the distance from an object to the lens. The image distance is the distance from the lens to the image.

Figure 16 shows how the image distance changes with the object distance, for two identically shaped convex lenses, **A** and **B**. Each lens is made from a different type of glass.

Figure 16



7 (d) (i) When the object distance is 4 cm, the image distance for lens **A** is longer than for lens **B**.

State why.

[1 mark]

Do not write outside the box

7 (d) (ii) When the object is moved between lens **B** and the principal focus, the image size changes. **Table 2** shows the magnification produced by lens **B** for different object distances.

Table 2

Object distance in cm	Magnification
0.0	1
5.0	2
6.7	3
7.5	4
8.0	5

Using information from **Figure 16** and **Table 2**, describe the relationship between the **image** distance and the magnification produced by lens **B**.

[2 marks]

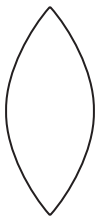
7 (d) (iii) A third convex lens, lens **C**, is made from the same type of glass as lens **B**, but has a shorter focal length than lens **B**.

Lens **B** is shown in **Figure 17**.

Complete **Figure 17** to show how lens **C** is different from lens **B.**

[1 mark]

Figure 17



Lens **B**

Lens **C**

12

END OF QUESTIONS

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AQA

GCSE

Physics

PH3HP

Mark scheme

4403

June 2016

Version/Stage: 1.0 Final Mark Scheme

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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Mark Scheme

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of errors / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(.....) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

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3.8 Accept / allow

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

3.9 Ignore / Insufficient / Do <u>not</u> allow

Ignore of insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

4. Quality of Communication and levels marking

In Question **1(b)** students are required to produce extended written material in English, and will be assessed on the quality of their communication as well as the standard of the scientific response.

Students will be required to:
- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic
- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear
- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed
- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)	an electromagnet can be switched off **or** an electromagnet is stronger	accept a permanent magnet cannot be switched off accept control the strength	1	AO1 P3.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(b)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.		6	AO1 AO2 P3.3.1a P3.3.1c

0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)
No relevant / correct content	there is a basic description of how to make an electromagnet **or** there is a basic description of how the strength of the electromagnet can be varied **or** there is a basic description of how the electromagnet can be tested	there is a description of how the electromagnet is made **and either** there is a description of how the strength of the electromagnet can be varied **or** there is a description of how the electromagnet can be tested	there is a description of how the electromagnet is made **and** there is a description of how the strength of the electromagnet can be varied **and** there is a description of how the strength of the electromagnet can be tested

Question 1b continues on the next page . . .

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examples of the points made in the response	extra information	
Details of how to make an electromagnet • wrap the wire around the nail • connect the wire to the power supply (with connecting leads and croc clips) • switch on the power supply	accept a current should be sent along the wire	
Details of how to vary the strength of the electromagnet • change the number of turns (on the coil) • change the current (through the coil) • change the separation of the turns	allow change the potential difference (across the coil) accept wrap the coil more tightly	
Details of how to test the electromagnet • suspend paperclips from the electromagnet • the more paperclips suspended, the stronger the electromagnet is • clamp the electromagnet at different distances from the paperclip(s) • the further the distance from which paperclips can be attracted the stronger the electromagnet is • test before and after making alterations to change the strength • compare the results from before and after making alterations • use de-magnetised paper clips	accept count the number of paperclips with different current **or** p.d. **or** no. of turns **or** core and see if the number changes/increases	

Total			7

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)	a magnetic field that is alternating / changing	accept electromagnetic field heat is insufficient	1 1	AO1 3.3.2d
2(b)	20	allow **1** mark for correct substitution, ie $\frac{230}{11.5}$ provided no subsequent step	2	AO2 3.3.2g
2(c)	(most) transformers are not 100% efficient	allow energy / power is lost to the surroundings allow energy / power is lost as heat / sound power is lost is insufficient	1	AO1 3.3.2h
2(d)(i)	0.01 (V) because there is a change in p.d. each time (the number of turns changes)	 allow because all the results (to 2 decimal places) are different accept if results were to 1 decimal place, there might not be a difference	1 1	AO3 3.3.2a 3.3.2b
2(d)(ii)	student 2 moved the coil more slowly (than student 1)	accept student 2 moved the coil at a different speed to student 1 do not accept student 2 moved the coil faster (than student 1)	1	AO3 3.3.2a 3.3.2b
2(d)(iii)	both sets of results show the same pattern	accept trend for pattern results are similar is insufficient results follow a pattern is insufficient	1	AO3 3.3.2a 3.3.2b

Question 2 continues on the next page . . .

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(d)(iv)	(electromagnetic) induction	accept it is induced do not accept electric / magnetic induction	1	AO1 3.3.2a
2(e)	any **one** from: • more economical / cheaper for the consumer • easier/cheaper to replace if broken/lost • since fewer transformers need to be made less resources are used	allow more convenient allow in case one gets lost allow fewer plug sockets are needed allow fewer transformers are needed environmentally friendly is insufficient	1	AO3 3.3.2
Total			11	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)	ultrasound is not ionising but X-rays are ionising so X-rays increase the health risk to the (unborn) baby	allow ultrasound does not harm the (unborn) baby accept specific examples of health risks, eg cancer, stunted growth, impaired brain function etc X-rays are dangerous is insufficient	1 1 1	AO1 3.1
3(b)	ultrasound/waves are partially <u>reflected</u> (when they meet a boundary) (between two different media / substances / tissues) the time taken is measured (and is used to determine distances)	must be clear that not all of the wave is reflected	1 1	AO1 3.1.2b
3(c)	1600 (m/s)	800 (m/s) gains **2** marks 160 000 (m/s) gains **2** marks 0.0016 (m/s) gains **2** marks allow **2** marks for $\frac{0.04}{25 \times 10^{-6}}$ or $\frac{0.08}{50 \times 10^{-6}}$ 80 000 (m/s) gains **1** mark 0.0008 (m/s) gains **1** mark allow **1** mark for $\frac{0.04}{25}$ or $\frac{0.08}{50}$ allow **1** mark for evidence of doubling the distance or halving the time	3	AO2 3.1.2c

Question 3 continues on the next page . . .

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(d)(i)	they are absorbed by bone	allow stopped for absorbed X-rays are reflected negates this mark	1	AO1 3.1.1a
	they are transmitted by soft tissue	allow pass through for transmitted allow flesh / muscle / fat accept less (optically) dense material for soft tissue	1	
	(the transmitted) X-rays are detected		1	
3(d)(ii)	short	accept small	1	AO1 3.1.1a
Total			12	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	angle of incidence: A angle of refraction: D		1	AO1 3.1.3a 3.1.3c
4(b)	42 (degrees)	an answer of 41.8° gains **2** marks an answer that rounds to 42° gains **2** marks an answer of 37 gains **2** marks allow **1** mark for correct substitution i.e. $\sin(c) = \frac{1}{1.5}$ **or** sin(c) = 0.67 provided no subsequent steps	3	AO2 3.1.5a
4(c)	• ray B took longer than ray A (to travel through the optical fibre) • so the pulse spreads out	allow ray B travels further than ray A allow the rays emerge at different times	1 1	AO3 3.1.5b
Total			6	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)(i)	turning effect	accept force multiplied by perpendicular distance from the line of action of the force to the pivot	1	AO1 3.2.2a
5(a)(ii)	moments are equal (in size) and opposite (in direction)	both parts are required allow clockwise moment = anticlockwise moment	1	AO1 3.2.2c
5(a)(iii)	0.9 (N)	allow **2** marks for $F=0.18 \div 0.2$ provided no subsequent steps allow **1** mark for (anticlockwise moment) = 0.18 (Nm) allow **1** mark for correct substitution i.e. 1.5 × 0.12 = F × 0.20	3	AO2 3.2.2e
5(b)	a longer drumstick lever gives a quieter sound a longer drumstick lever allows a greater range of volumes	a greater force gives a louder sound is insufficient	1 1	AO3 3.2.2e
Total			7	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)(i)	the point where the mass is (thought to be) concentrated		1	AO1 3.2.1a
6(a)(ii)	the centre of mass is higher the base (area) is smaller / narrower		1 1	AO2 3.2
6(b)	(the blocks at A and B) create equal and opposite moments the resultant moment is zero **or** the block at A creates an anti-clockwise moment (1) so this must be balanced by an equal clockwise moment from the block at B (1)	 accept (moments are in) equilibrium / balanced	1 1	AO1 3.2.2c
Total			5	

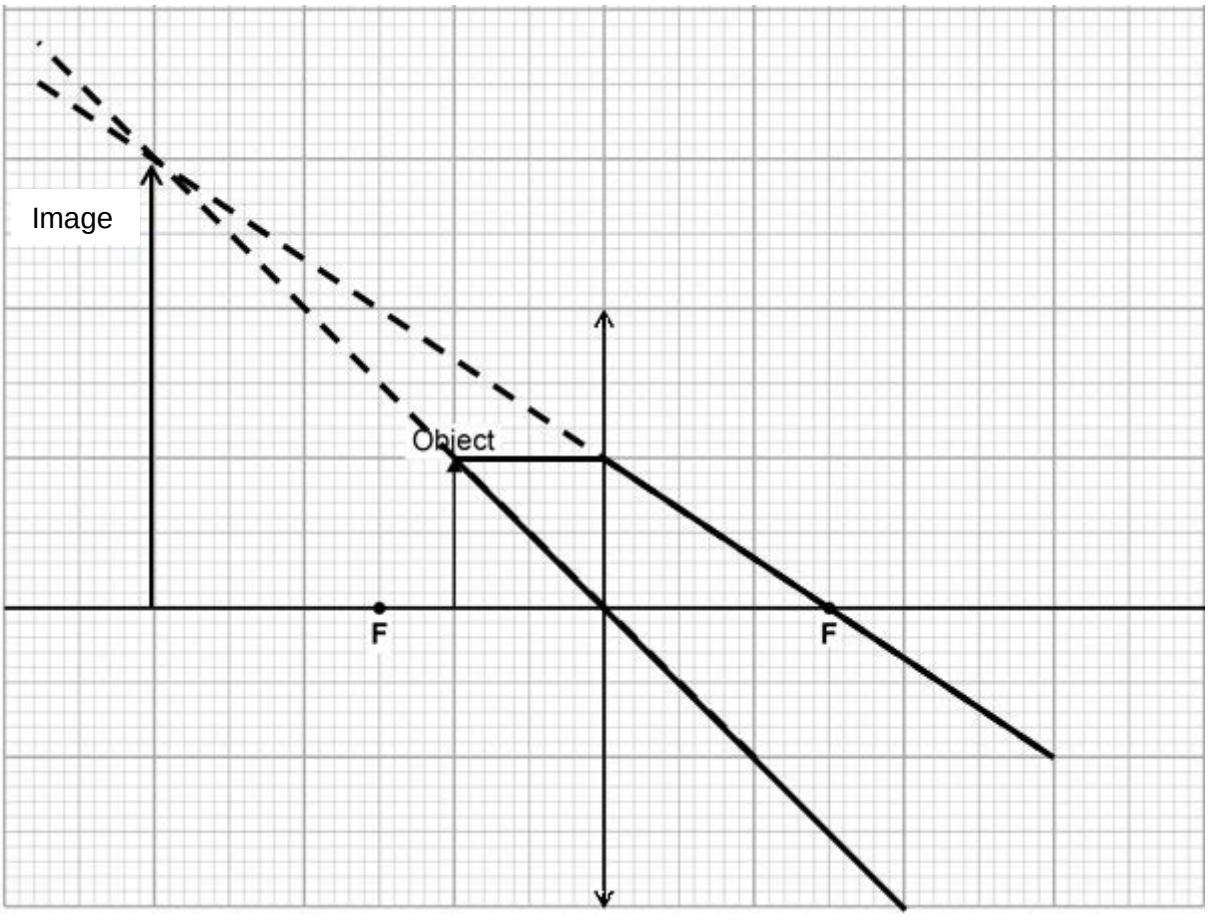
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Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)(i)	the eyeball is too short **or** the lens is too weak/thin	accept the light is focussed behind the retina accept the lens is unable to focus accept the cornea is not curved enough old age / inherited is insufficient	1	AO1 3.1.4b
7(a)(ii)	a laser		1	AO1 3.1.5c
7(b)	the image would decrease in size the image would change (from virtual) to real the image would change (from non-inverted) to inverted	 accept that the image (of bulb M) can be projected on to a screen 	1 1 1	AO1 3.1.3d

Question 7 continues on the next page . . .

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7(c)	a ray through the centre of the lens	rays should be drawn with a ruler ignore arrows	1	AO2 3.1.3h
	a ray parallel to the principal axis and passing through the principal focus to the right of lens	accept solid or dashed lines accept a ray drawn as if from the principal focus to the left of the lens, emerging parallel to the principal axis	1	
	image drawn where rays cross	image should be to left of the lens	1	



Question 7 continues on the next page . . .

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(d)(i)	(because the glass in) lens A has a greater refractive index	accept lens A is more powerful accept lens A has a shorter focal length	1	AO3 3.1.3f
7(d)(ii)	when the magnification increases by 1, the image distance increases by 10 cm	accept for **1** mark it is a linear pattern or as the image distance increases, the magnification increases do **not** accept directly proportional	2	AO3 3.1.3i
7(d)(iii)	diagram showing the surfaces of a convex lens C having greater curvature than lens B	the size of the lens drawn is not important	1	AO1 3.1.4f
Total			12	

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
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6	
7	
8	
TOTAL	

AQA

General Certificate of Secondary Education
Higher Tier
June 2015

Physics
Unit Physics P3

PH3HP

H

Wednesday 20 May 2015 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

A

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(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.

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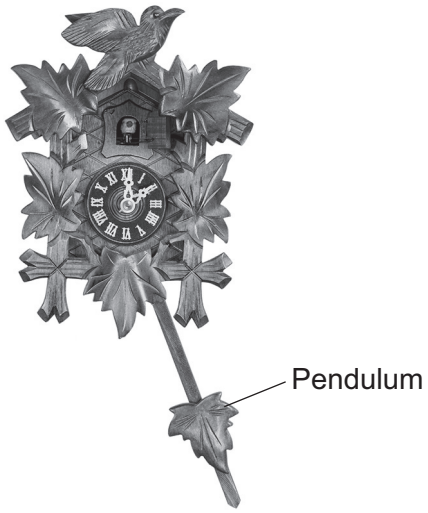
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ANSWER IN THE SPACES PROVIDED

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

1 The clock shown in **Figure 1** uses a pendulum to keep time.

Figure 1



1 (a) The pendulum has a frequency of 0.80 Hz.

Calculate the periodic time of the pendulum.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

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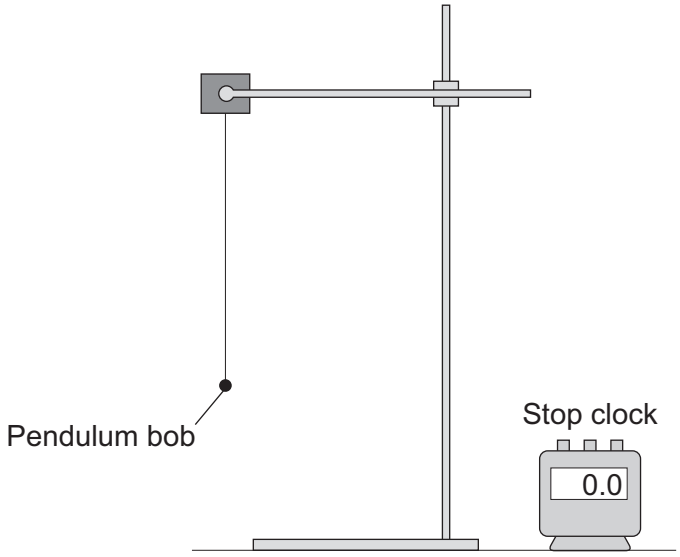
Periodic time = ... seconds

Question 1 continues on the next page

Do not write outside the box

1 (b) A student investigated the factors affecting the oscillation of a pendulum. The student set up a pendulum as shown in **Figure 2**.

Figure 2



The student investigated how many complete oscillations the pendulum made for different lengths of the pendulum and different masses of the pendulum bob.

The results are shown in **Table 1**.

Table 1

Length of the pendulum in millimetres	Mass of the pendulum bob in grams	Number of complete oscillations made by the pendulum in 20 seconds
200	100	22
200	200	22
400	100	15
400	200	15
600	50	13
600	100	13

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1 (b) (i) State **two** conclusions that the student should make from the results shown in **Table 1**.

[2 marks]

1 .....

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2 .....

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1 (b) (ii) The student wants to be more certain that her conclusions are correct.

Suggest **two** ways in which the investigation could be improved.

[2 marks]

1 .....

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2 .....

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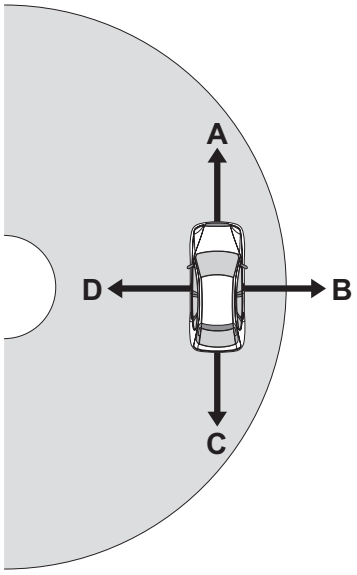
6

Turn over for the next question

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2 (a) **Figure 3** shows a car travelling around a bend in the road. The car is travelling at a constant speed.

Figure 3



There is a resultant force acting on the car. This resultant force is called the centripetal force.

2 (a) (i) In which direction, **A**, **B**, **C** or **D**, does the centripetal force act on the car?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

2 (a) (ii) State the name of the force that provides the centripetal force.

[1 mark]

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Do not write outside the box

2 (a) (iii) State **two** factors that affect the size of the centripetal force acting on the car.

[2 marks]

1 .....

2 .....

2 (b) **Figure 4** shows a racing car.

Figure 4



The racing car should not roll over when racing.

State **two** features of the car that make it difficult for the car to roll over.

[2 marks]

1 .....

.....

2 .....

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6

Turn over for the next question

Do not write outside the box

3 (a) Complete the following sentences.

[2 marks]

Ultrasound waves have a minimum frequency

of ..... hertz.

The wavelength of an X-ray is about the same as

the diameter of ..... .

3 (b) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Figure 5 shows one medical use of ultrasound and one medical use of X-rays.

Figure 5





Compare the medical uses of ultrasound and X-rays.

Your answer should include the risks, if any, and precautions, if any, associated with the use of ultrasound and X-rays.

[6 marks]

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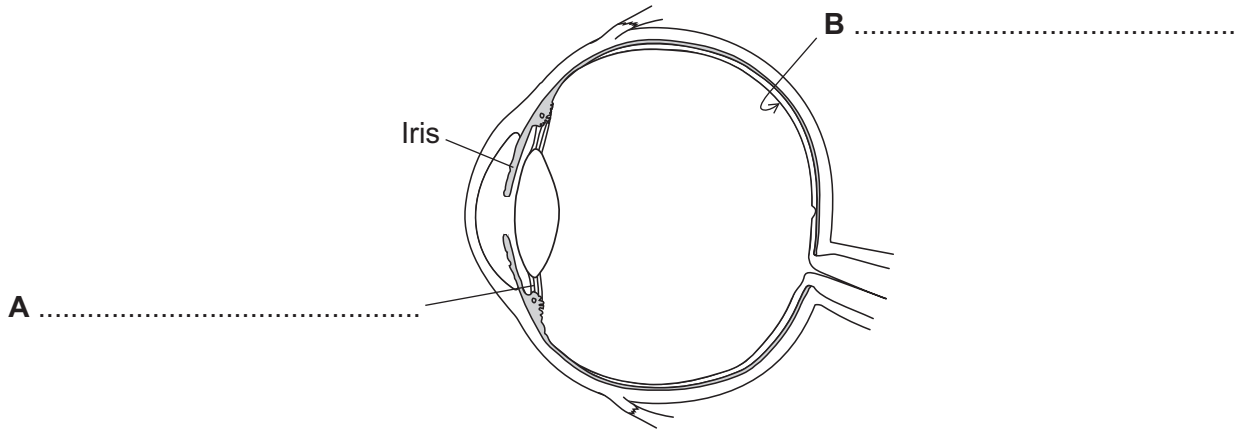
8

Turn over for the next question

Do not write outside the box

4 (a) **Figure 6** shows a diagram of a human eye.

Figure 6



Label the parts **A** and **B** on **Figure 6**.

[2 marks]

4 (b) State the function of the iris.

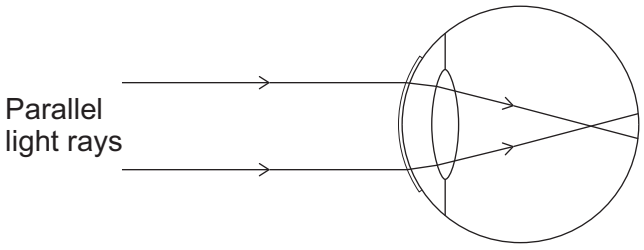
[1 mark]

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4 (c) **Figure 7** shows light rays travelling into the human eye.

Figure 7



4 (c) (i) Give the name of the defect of vision shown in **Figure 7**.

[1 mark]

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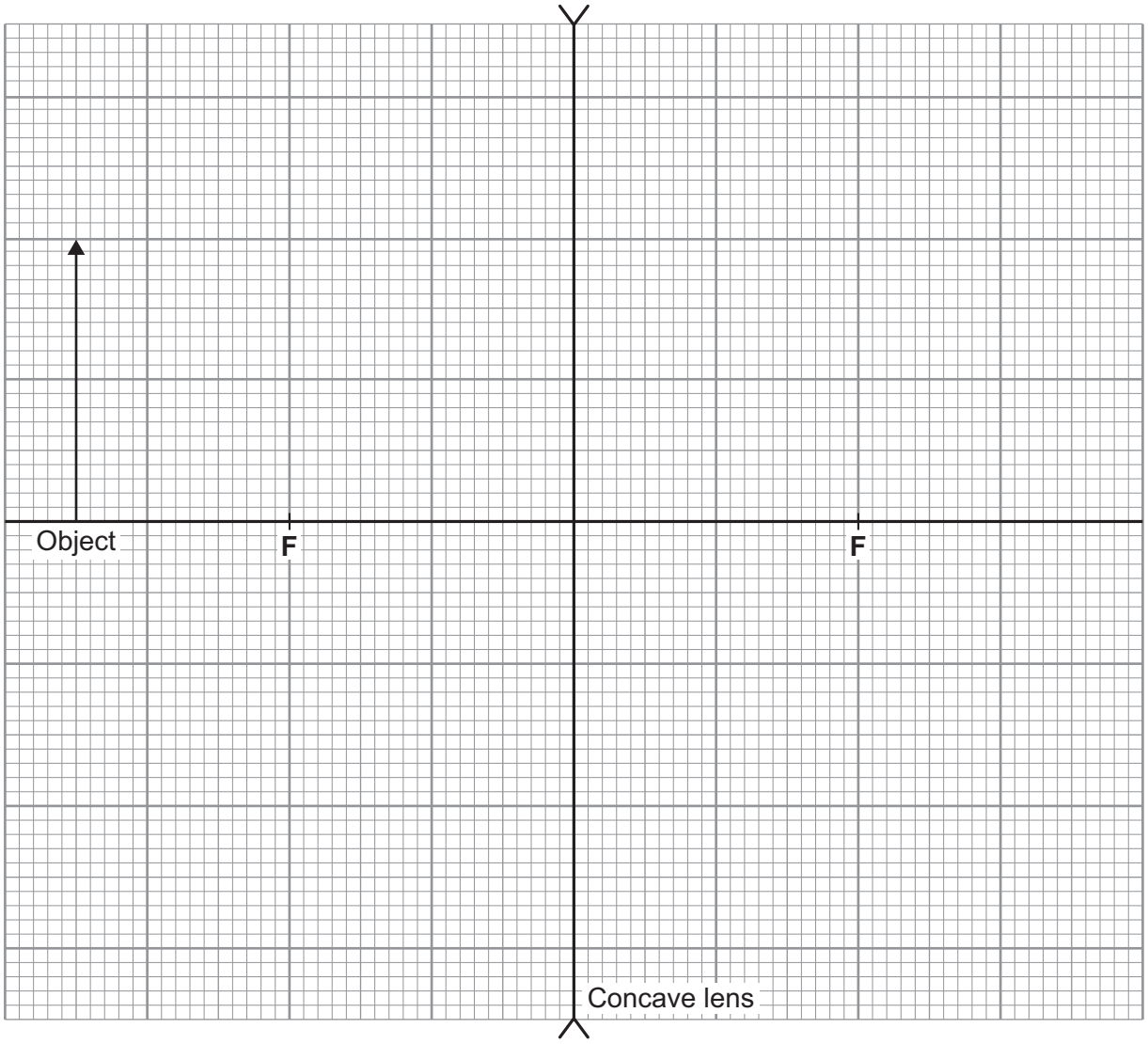
4 (c) (ii) A concave (diverging) lens can be used to correct the defect of vision shown in **Figure 7**.

Complete the ray diagram in **Figure 8** to show how a concave lens produces an image of the object.

Use an arrow to represent the image.

[3 marks]

Figure 8



4 (d) It is important that muscles can change the power of the lens in the eye.
State why.

[1 mark]

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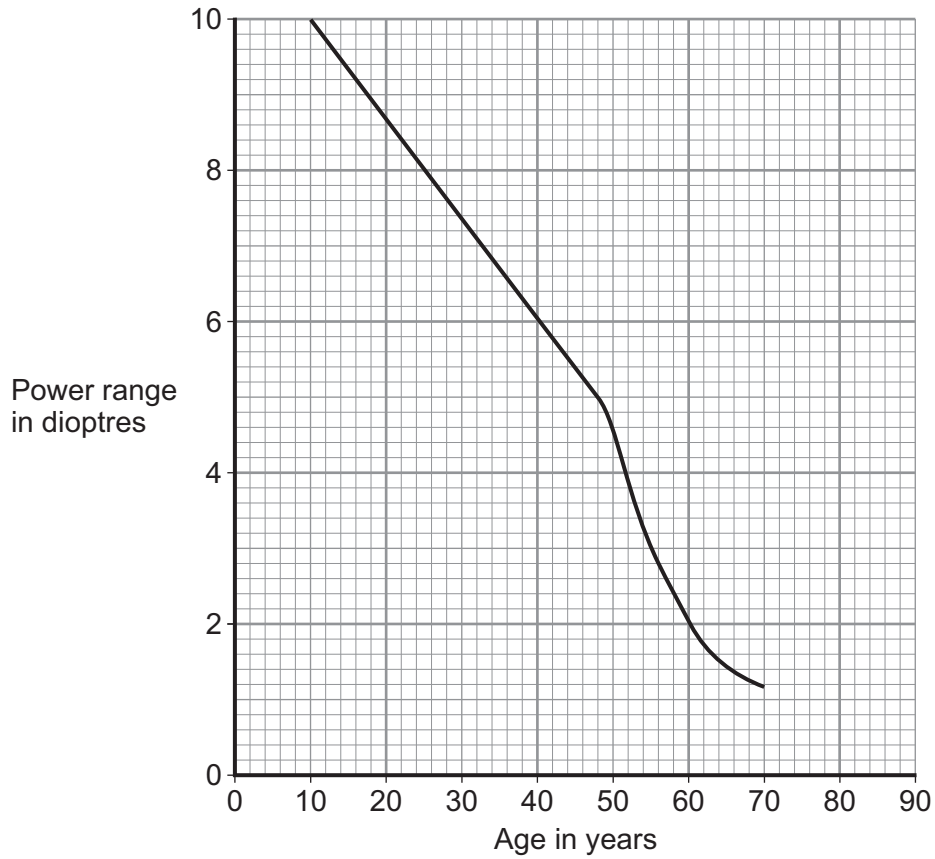
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4 (e) The 'power range' of an eye lens is the difference between the maximum and minimum power of the lens.

Figure 9 shows how the power range of an eye lens changes with age.

Figure 9



4 (e) (i) Use data from **Figure 9** to calculate the maximum change that can happen to the **focal length** of the eye lens for a 60-year-old person.

Use the correct equation from the Physics Equations Sheet.

Give the unit.

[2 marks]

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Maximum change in focal length = ... unit .....

Do not write outside the box

4 (e) (ii) Compare the change in power range of the eye lens between the ages of 10 and 30 with that between the ages of 50 and 70.

[3 marks]

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4 (e) (iii) Use **Figure 9** to suggest the power range of the eye lens for a 90-year-old person.

[1 mark]

Power range = ... dioptres

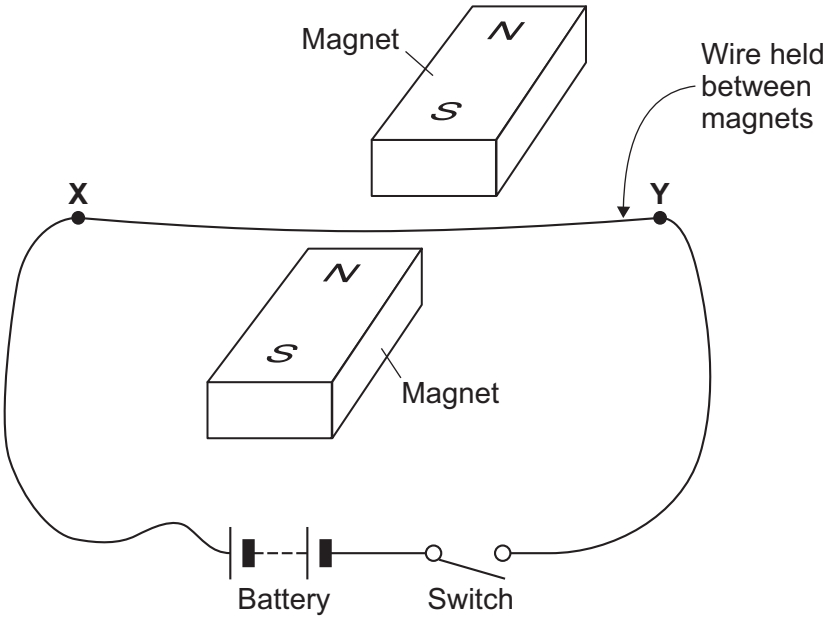
14

Turn over for the next question

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5 **Figure 10** shows apparatus set up by a student.

Figure 10



Closing the switch creates a force that acts on the wire **XY**.

5 (a) (i) Explain why a force acts on the wire **XY** when the switch is closed.

[3 marks]

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5 (a) (ii) The force causes the wire **XY** to move.
Draw an arrow on **Figure 10** to show the direction in which the wire **XY** will move.

[1 mark]

5 (a) (iii) State the effect that this experiment demonstrates.

[1 mark]

.....

Do not write outside the box

5 (b) The student replaced the battery with a low frequency alternating current (a.c.) power supply.

The student closed the switch.

5 (b) (i) Describe the movement of the wire.

[1 mark]

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5 (b) (ii) Give a reason for your answer to part **(b)(i)**.

[1 mark]

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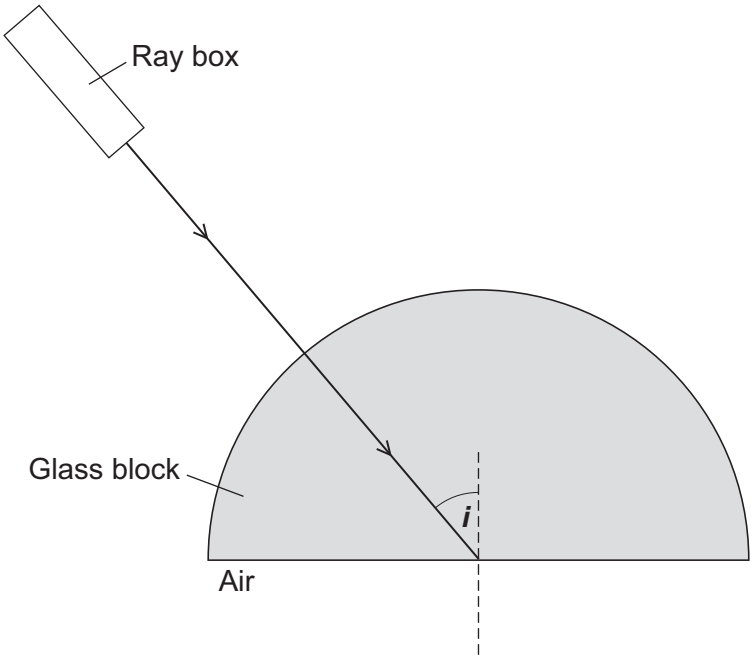
7

Turn over for the next question

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6 **Figure 11** shows a ray of light travelling through a semicircular glass block. The angle of incidence is labelled ***i***.

Figure 11



6 (a) (i) The angle of incidence ***i*** equals the critical angle for the glass.

Complete **Figure 11** to show what happens to the ray of light at the glass-to-air boundary.

[1 mark]

6 (a) (ii) The critical angle for the glass is 41°.

Calculate the refractive index of the glass.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

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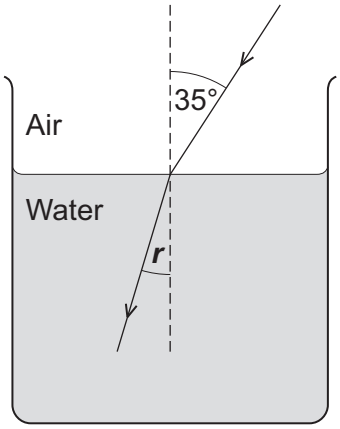
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Refractive index = ...

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6 (b) **Figure 12** shows what happens to a ray of light as it meets the boundary between air and water.

Figure 12



Not to scale

The refractive index of the water is 1.3

Calculate the angle of refraction ***r***.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

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Angle of refraction = ... degrees

6

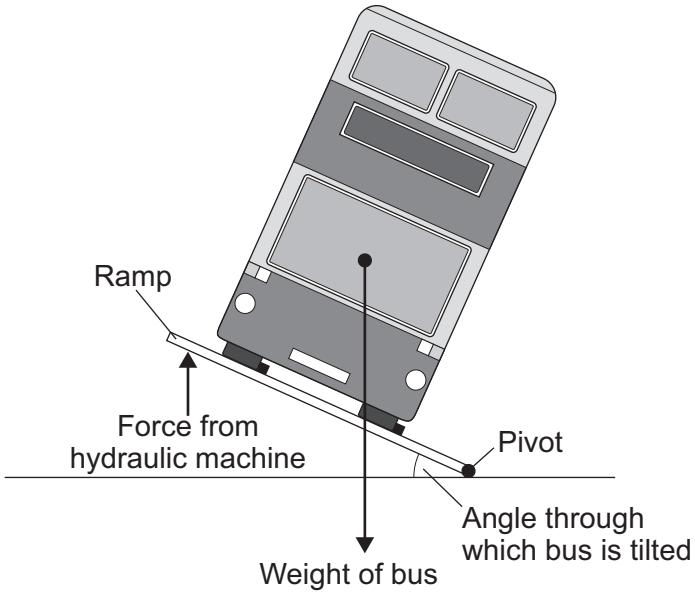
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7 Before a new bus can be used on the roads, it must pass a stability test. **Figure 13** shows how the bus is tested.

Figure 13

Front view



7 (a) (i) The bus will topple over if the ramp is tilted at too great an angle.

Explain why.

[2 marks]

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7 (a) (ii) The bus is tested to angles of tilt far greater than it would experience in normal use.

Suggest **two** reasons why.

[2 marks]

1 .....

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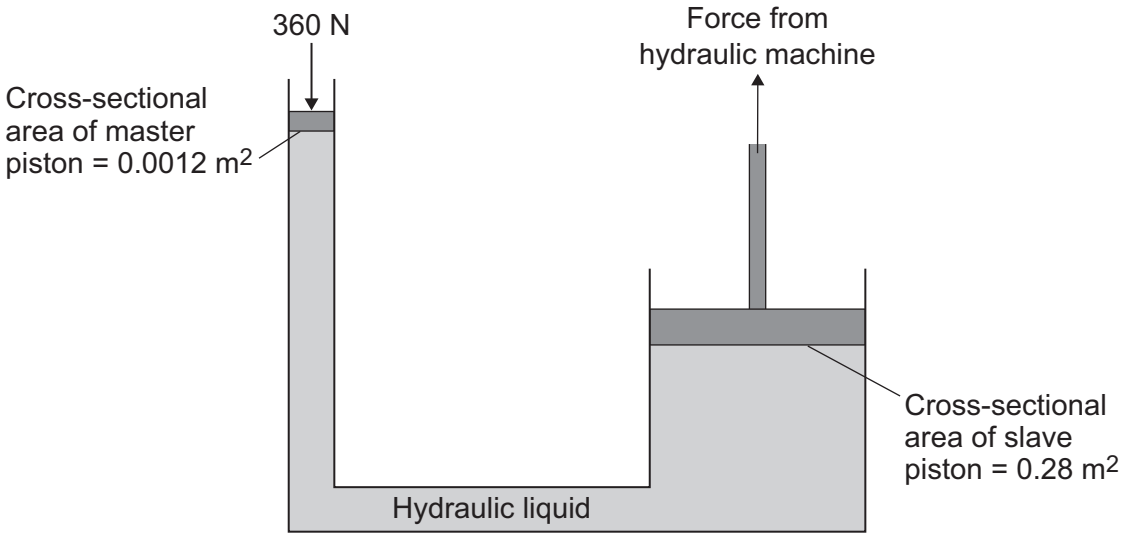
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7 (b) **Figure 14** shows the hydraulic machine that is used to make the ramp tilt.

Figure 14



The pressure applied to the hydraulic liquid at the master piston is the same as the pressure applied by the hydraulic liquid to the slave piston.

7 (b) (i) State the property of the liquid that keeps the pressure at both pistons the same.

[1 mark]

.....

7 (b) (ii) A 360 N force acts on the master piston.

Use information from **Figure 14** to calculate the force applied by the hydraulic liquid to the slave piston.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

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Force = ... N

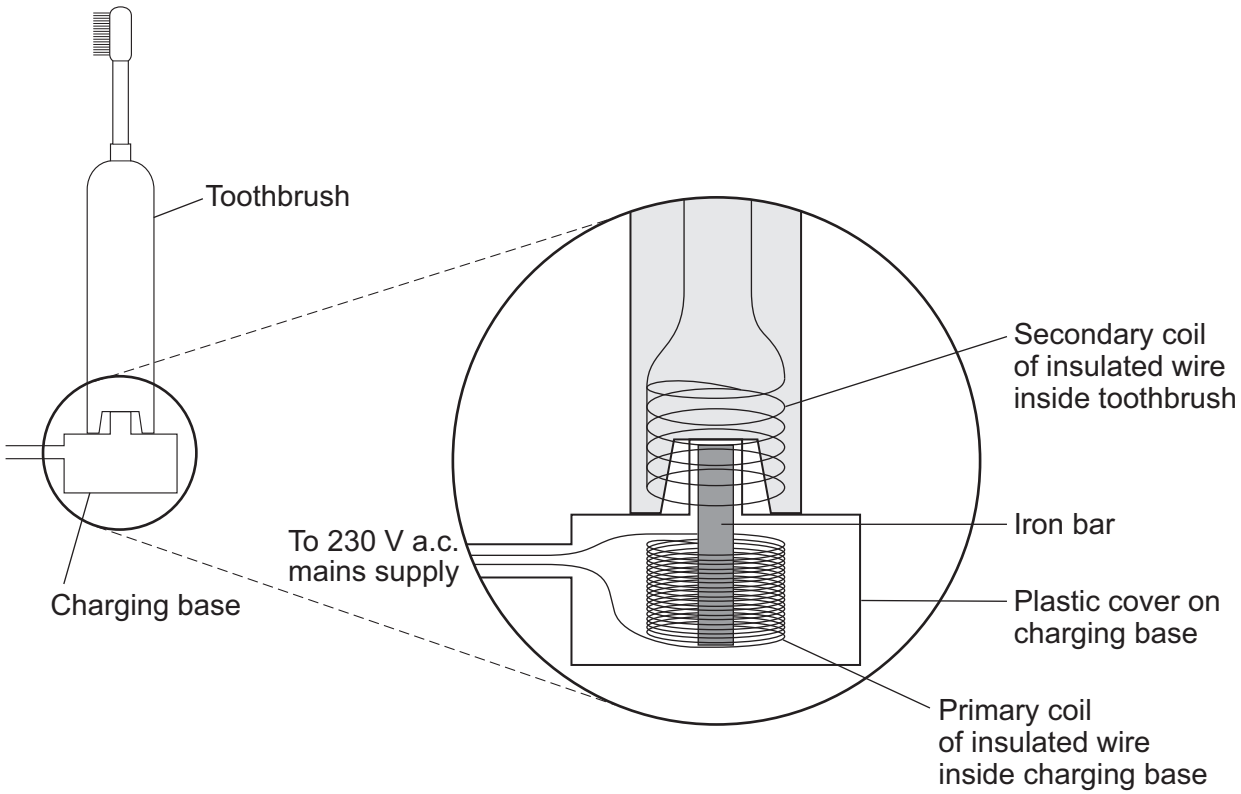
8

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8 An electric toothbrush is charged by standing it on a separate charging base. **Figure 15** shows the inside of the electric toothbrush and the charging base.

Figure 15



8 (a) An alternating potential difference (p.d.) across the coil in the charging base creates an alternating current in the coil inside the toothbrush.

Explain how.

[3 marks]

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8 (b) When the toothbrush is being charged, the p.d. across the primary coil in the charging base is 230 V.

The charging p.d. across the secondary coil in the toothbrush is 7.2 V.

The primary coil in the charging base has 575 turns of wire on its coil.

Calculate the number of turns on the secondary coil inside the toothbrush.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

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.....

Number of turns on the secondary coil = ...

5

END OF QUESTIONS

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GCSE

Physics

PH3HP

Mark scheme

4403

June 2015

Version/Stage: 1.0: Final

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Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

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Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a candidate writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

Quality of Written Communication and levels marking

In Question 3(b) candidates are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Candidates will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

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Question	Answers	Extra information	Mark	AO / Spec. ref.
1(a)	1.25	accept 1.3 for **2** marks allow **1** mark for correct substitution ie $\frac{1}{0.8}$ provided no subsequent step shown	2	AO2 P3.2.1d
1(b)(i)	increasing the length (of the pendulum) decreases the number of oscillations / swings made (in 20 seconds)	accept increasing the length (of the pendulum) increases the time (of 1 oscillation / swing) accept increasing the length (of the pendulum) decreases the speed/frequency (of 1 oscillation / swing) answers must refer to the effect of increasing/decreasing length ignore references to time being proportional to length	1	AO3 P3.2.1e
	changing the mass (of the pendulum bob) does not change the number of oscillations / swings made (in 20 seconds)	accept changing the mass does not change the time/speed/frequency/results accept weight for mass	1	

Question 1 continues on the next page . . .

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Question	Answers	Extra information	Mark	AO / Spec. ref.
1(b)(ii)	any **two** suitable improvements: • measure (the number of swings) over a wider range of (pendulum) lengths • measure (the number of swings) over a wider range of (bob) masses • measure the number of swings made over a greater period of time • repeat each measurement & calculate mean / average (number of oscillations in 20 seconds) • measure (the total number of swings &) the fraction of swings made • start the swings at the same height	accept repeat measurements & discard anomalous measurements repeat measurements is insufficient use a computer / datalogger to make measurement (of number of oscillations) is insufficient measuring time period is insufficient using a stop clock with greater resolution is insufficient	2	AO3 P3.2.1
Total			6	

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Question	Answers	Extra information	Mark	AO / Spec. ref.
2(a)(i)	D		1	AO2 P3.2.4b
2(a)(ii)	friction		1	AO1 P3.2.4b
2(a)(iii)	any **two** from: • the speed / velocity • the radius of the bend • the mass (of the car)	 the radius is insufficient accept curvature of the road size of the bend is insufficient accept distance of car from centre (of bend) accept weight for mass	2	AO1 P3.2.4c
2(b)	the car has a wide base the car has a low centre of mass / gravity	accept any description of a wide base e.g. the wheels are far apart accept wide wheel base do **not** accept long wheel base a large surface area is insufficient wide tyre(s) is insufficient accept any description of low centre of mass e.g. mass is close to the ground a down force is insufficient	1 1	AO2 P3.2
Total			6	

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Question	Answers	Extra information	Mark	AO / Spec. ref.
3(a)	20,000	accept 20 kilo **or** 20 k **or** 20 001	1	AO1 P3.1.2a
	an atom		1	AO1 P3.1.1a

Question 3 continues on the next page . . .

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(b)			6	AO1 P3.1 P3.1.1c

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 4 and apply a 'best-fit' approach to the marking.

0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)
no relevant content	At least one relevant statement is given for either type of wave	**Either** a use, risk and precaution is given for one type of wave **Or** A medical use is given for both types of wave **plus** a risk or precaution for one type of wave	At least one medical use is given for both types of wave linked to the risks and any precautions necessary

examples of the points made in the response	extra information
<u>Medical use of X-rays</u> Any one from: • Detecting bone fractures • Detecting dental problems • Killing cancer cells • CT scanning	Ignore details about how X-rays/ultrasound work accept any specific use of X-rays, eg • detecting heart/lung disorders (with chest X-rays) • mammograms / breast cancer detection • detecting stones / bowel disease (with abdominal X-rays)
<u>Risks with X-rays</u> X-rays pose a risk / danger / hazard	accept are harmful
X-rays cause ionisation / damage to cells **or** mutate cells / cause mutations / increase chances of mutations **or** turn cells cancerous / produce abnormal growths / produce rapidly growing cells **or** kill cells	accept a description of what ionising is instead of cell, any of these words can be used: DNA / genes / chromosomes / nucleus accept (may) cause cancer

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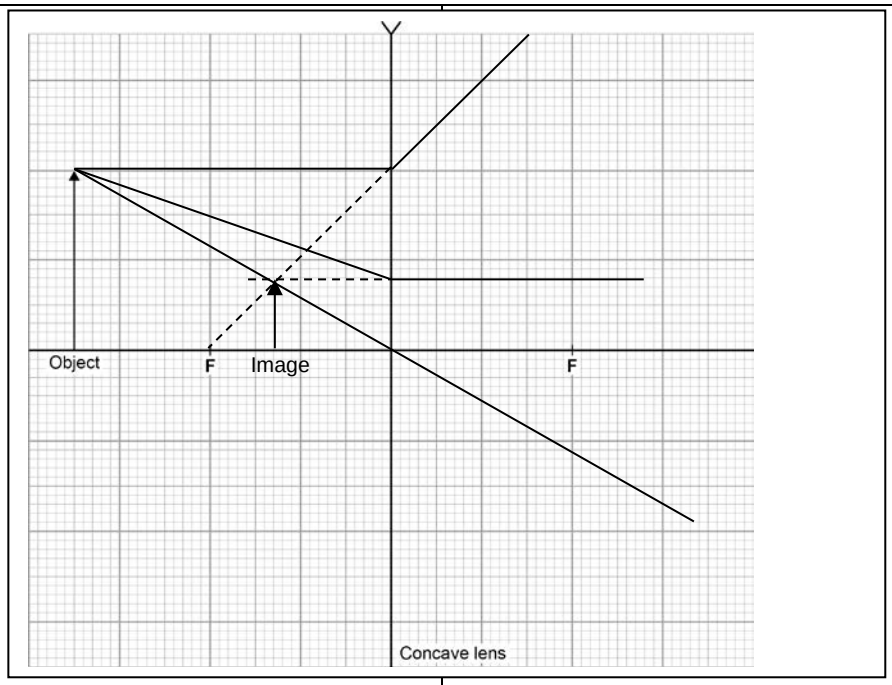
Operator precautions with X-rays The X-ray operator should go behind a (metal / glass) screen / leave the room when making an X-ray / wear a lead lined apron	accept appropriate precautions for the patient e.g. limit the total exposure/dose (in one year) wear a radiation badge is insufficient	
Medical use of ultrasound Any one from: • Pre-natal scanning • Imaging (a named body part). • removal / destruction of kidney / gall stones • removing plaque from teeth • repair of damaged tissue / muscle	cleaning teeth is insufficient accept examples of repair, eg alleviating bruising, repair scar damage, ligament / tendon damage, joint inflammation accept physiotherapy accept curing prostate cancer **or** killing prostate cancer cells	
Risks with ultrasound Ultrasound poses no risk / danger / hazard (to the user / patient). Ultrasound is not ionising or Ultrasound does not damage (human) cells	accept ultrasound is safer than using X-rays.	
Precautions with ultrasound The operator needs to take no precautions when making an ultrasound scan.	this can be assumed if it is stated that ultrasound is harmless or it is safer than using x-rays or it is non-ionising	

Total		**8**

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Question	Answers	Extra information	Mark	AO / Spec. ref.
4(a)	**A** = suspensory ligament **B** = retina		1 1	AO1 P3.1.4a
4(b)	to control the amount of light entering the eye **or** to control the amount of light incident on the retina	allow change the size of the pupil	1	AO1 P3.1.4a
4(c)(i)	short sight **or** myopia	accept near sight	1	AO1 P3.1.4b

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Question	Answers	Extra information	Mark	AO / Spec. ref.
4(c)(ii)				AO1 AO2 P3.1.3h
	any 2 correct construction lines:	construction lines may be dotted or solid construction lines must pass correctly through the lens treat more than 2 construction lines as a list for marking	2	
	upright image drawn at correct location.	image must be to the left of the lens upright orientation of image must be clear the image line can be dotted or solid ignore any arrows on construction rays	1	

Question 4 continues on the next page . . .

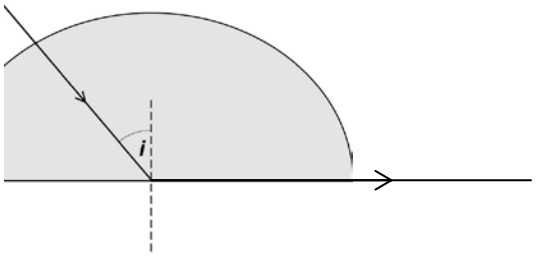
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Question	Answers	Extra information	Mark	AO / Spec. ref.
4(d)	to focus light from objects at different distances	accept can see objects (clearly) at different distances. to focus light on the retina is insufficient	1	AO1 P3.1.4e
4(e)(i)	0.5 metre(s) / m	the unit is **not** an independent mark an answer 0.5 without a unit or with an incorrect unit scores **1** mark **or** a substitution 2 = 1/f with the unit metre(s)/m scores **1** mark	2	AO1 AO2 P3.1.4e
4(e)(ii)	10 to 30 decreases linearly or at a constant rate 50 to 70 falls less rapidly after 60 years 10 to 30 decrease is less than 50 to 70	accept from 10 to 30 the decrease is 2.6/2.7(D) accept it decreases at a decreasing rate accept from 50 to 70 the decrease is 3.3/3.4(D)	1 1 1	AO3 P3.1.4c
4(e)(iii)	0.8 (D)	accept answers in the range of 0.6 to 1.0 (D) inclusive	1	AO3 P3.1.4c
Total			14	

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Question	Answers	Extra information	Mark	AO / Spec. ref.
5(a)(i)	(closing the switch makes) a current (through the wire) (the current flowing) creates a magnetic field (around the wire) this field interacts with the permanent magnetic field	 accept links / crosses attracts / repels is insufficient	1 1 1	AO1 P3.3.1a, b
5(a)(ii)	arrow drawn showing upwards force on XY	judge vertical by eye the arrow must be on or close to the wire XY	1	AO2 P3.3.1e
5(a)(iii)	motor	accept catapult	1	AO1 P3.3.1b
5(b)(i)	the wire moves up and down or the wire vibrates	 back and forth or side to side is insufficient for vibrate	1	AO2 P3.3.1e
5(b)(ii)	the force (continually) changes direction (from upwards to downwards, on the wire)	accept the direction of the magnetic field (of the wire) changes	1	AO1 P3.3.1e
Total			7	

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Question	Answers	Extra information	Mark	AO / Spec. ref.
6(a)(i)	line drawn at 90 degrees to the normal:  	ignore (partial) reflection of the ray	1	AO1 P3.1.5a
6(a)(ii)	1.5	award both marks for an answer that rounds to 1.5 award **1** mark for correct substitution ie 1 / sin 41 **or** 1 / 0.656(059)	2	AO2 P3.1.5a
6(b)	26	award **3** marks for an answer that rounds to 26 award **2** marks for $1.3 = \frac{0.57(3576)}{\sin r}$ or $r = \sin^{-1}(0.57(3576) / 1.3)$ award **1** mark for correct substitution.ie $1.3 = \frac{\sin 35}{\sin r}$ or sin 35° shown correctly, ie 0.57(3576), or used correctly in the calculation an answer of 0.44 scores 2 marks an answer of 26.9 scores 0	3	AO2 P3.1.3c
Total			6	

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Question	Answers	Extra information	Mark	AO / Spec. ref.
7(a)(i)	the line of action of the weight (of the bus) lies / acts outside of the base (of the bus) there is a resultant <u>moment</u> (acting on the bus)	allow line of action through the centre of mass lies / acts outside the base	1 1	AO1 P3.2.2f
7(a)(ii)	in normal use the centre of mass may be in a different position **or** passengers on the bus may affect the position of the centre of mass for safety, buses should always be tested beyond the normal operating conditions / parameters	 for safety is insufficient accept in case something unexpected happens	1 1	AO3 P3.2.2
7(b)(i)	a liquid is (virtually) incompressible	accept a liquid cannot be squashed a liquid is difficult to compress is insufficient	1	AO1 P3.2.3a

Question 7 continues on the next page . . .

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Question	Answers	Extra information	Mark	AO / Spec. ref.
7(b)(ii)	84000	award **2** marks for $\frac{F}{0.28} = \frac{360}{0.0012}$ **or** $\frac{F}{0.28} = 300\ 000$ **or** award **1** mark for $P = \frac{360}{0.0012}$ **or** 300 000 (Pa) seen anywhere	3	AO2 P3.2.3b, c
Total			8	

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Question	Answers	Extra information	Mark	AO / Spec. ref.
8(a)	an alternating current through the primary coil (in the charging base) causes a changing / alternating magnetic field in / around the (iron) bar which <u>induces</u> an (alternating) p.d. across the secondary coil (in the toothbrush)	it must be clear which coil is being referred to accept <u>induces</u> an (alternating) current in the secondary coil	1 1 1	AO1 P3.3.2d
8(b)	18	allow **1** mark for correct substitution, ie $\frac{230}{7.2} = \frac{575}{n_s}$	2	AO2 P3.3.2g
Total			5	

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

AQA

General Certificate of Secondary Education
Higher Tier
June 2014

Physics
Unit Physics P3

PH3HP

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

A

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.

Do not write outside the box

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

1 (a) What is ultrasound?

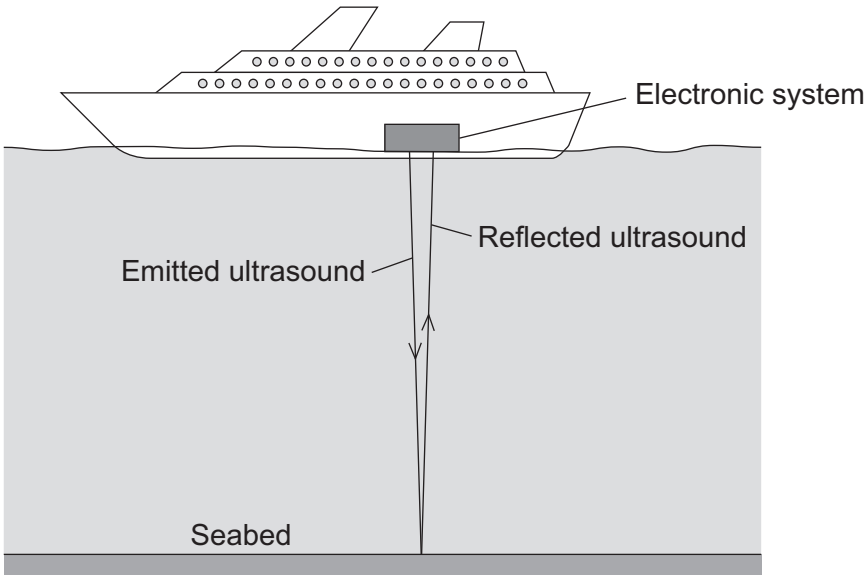
[1 mark]

.....

.....

1 (b) **Figure 1** shows how ultrasound is used to measure the depth of water below a ship.

Figure 1



A pulse of ultrasound is sent out from an electronic system on-board the ship.

It takes 0.80 seconds for the emitted ultrasound to be received back at the ship.

Calculate the depth of the water.

Speed of ultrasound in water = 1600 m/s

Use the correct equation from the Physics Equations Sheet.

[3 marks]

.....

.....

.....

.....

Depth of water = ... metres

Do not write outside the box

1 (c) Ultrasound can be used in medicine for scanning.

State **one** medical use of ultrasound scanning.

[1 mark]

.....

1 (d) Images of the inside of the human body can be made using a Computerised Tomography (CT) scanner. The CT scanner in **Figure 2** uses X-rays to produce these images.

Figure 2



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

[2 marks]

Advantage of CT scanning .....

.....

.....

Disadvantage of CT scanning .....

.....

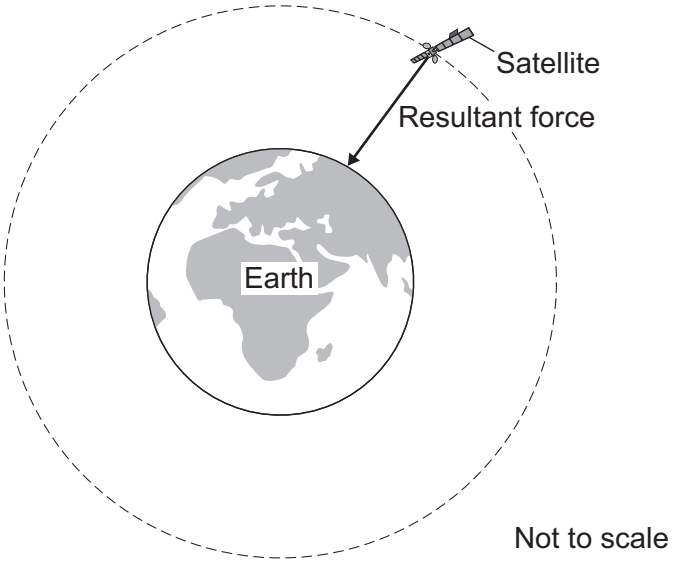
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7

Do not write outside the box

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

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 .....

Do not write outside the box

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]

.....

.....

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]

.....

.....

Question 2 continues on the next page

Do not write outside the box

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

Do not write outside the box

3 (a) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

There are two types of traditional transformer; step-up and step-down.

Describe the similarities and differences between a step-up transformer and a step-down transformer.

You should include details of:

- construction, including materials used
- the effect the transformer has on the input potential difference (p.d.).

You should **not** draw a diagram.

[6 marks]

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Extra space .....

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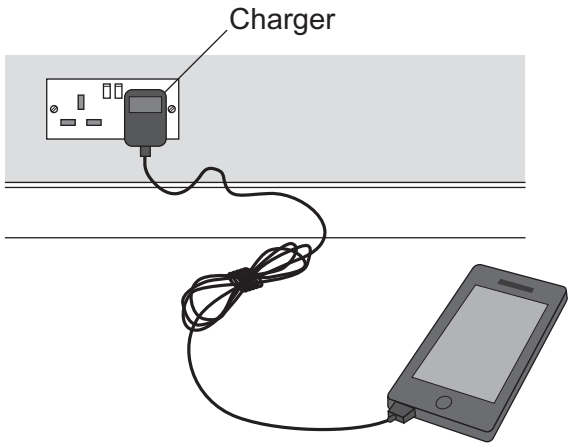
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Question 3 continues on the next page

Do not write outside the box

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]

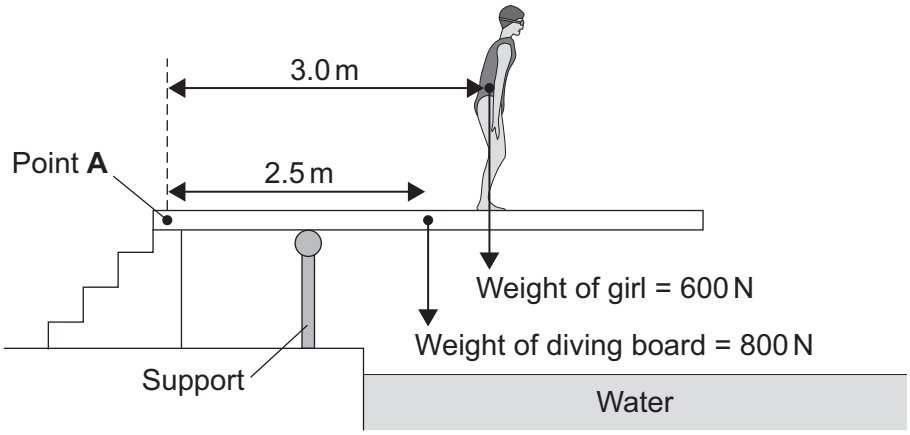
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7

Do not write outside the box

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

Figure 5



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]

.....

.....

.....

.....

.....

.....

.....

Total clockwise moment about Point **A** = ...

Question 4 continues on the next page

Do not write outside the box

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

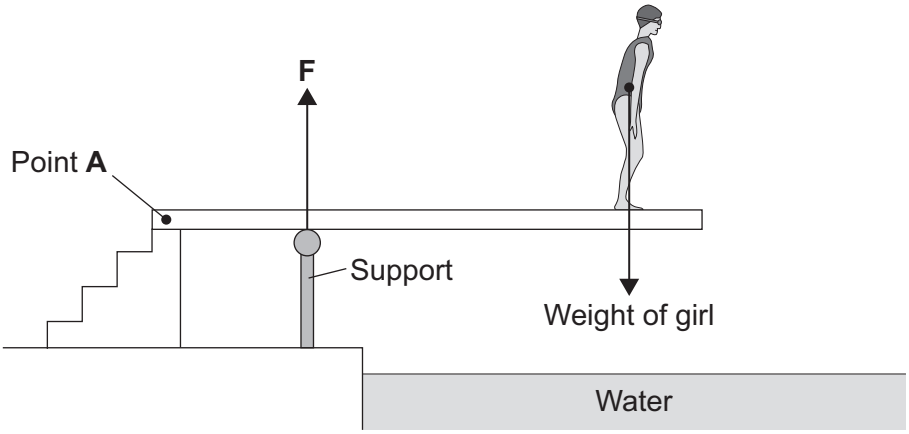
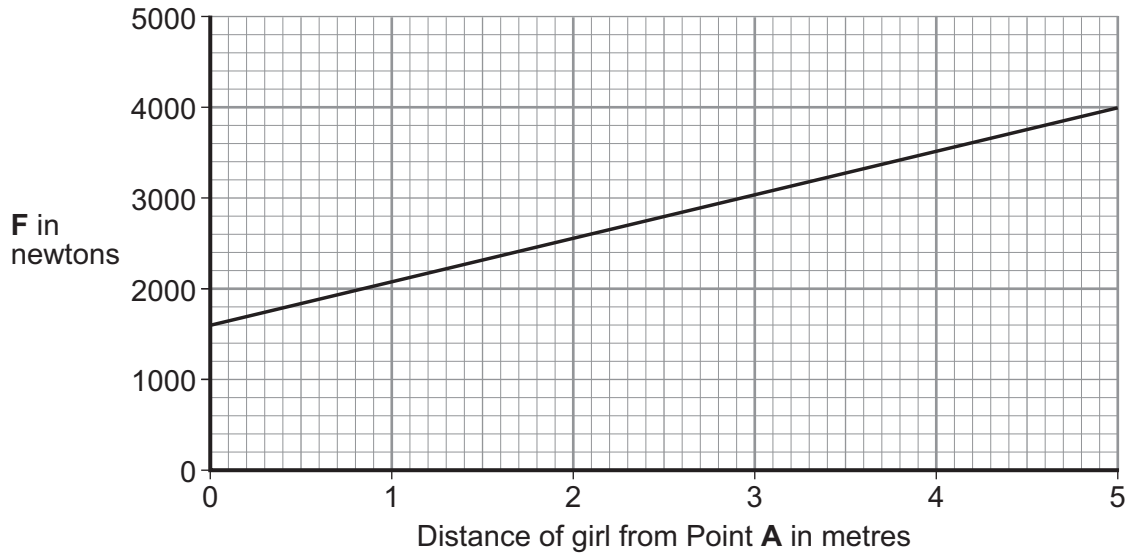


Figure 7 shows how the upward force **F** varies with the distance of the girl from Point **A**.

Figure 7



Do not write outside the box

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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.....

.....

7

Turn over for the next question

Do not write outside the box

5 (a) Human eyes and digital cameras both have 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	Retina	.....
Variable opening where light enters	.....	Aperture

5 (b) Long sight is a defect of the human eye.

State **two** causes of long sight.

[2 marks]

1 .....

.....

2 .....

.....

Do not write outside the box

5 (c) Long sight can be corrected by wearing spectacles with converging (convex) lenses.

A lens in these spectacles has a power of +3.2 dioptres.

Calculate the focal length of this lens.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

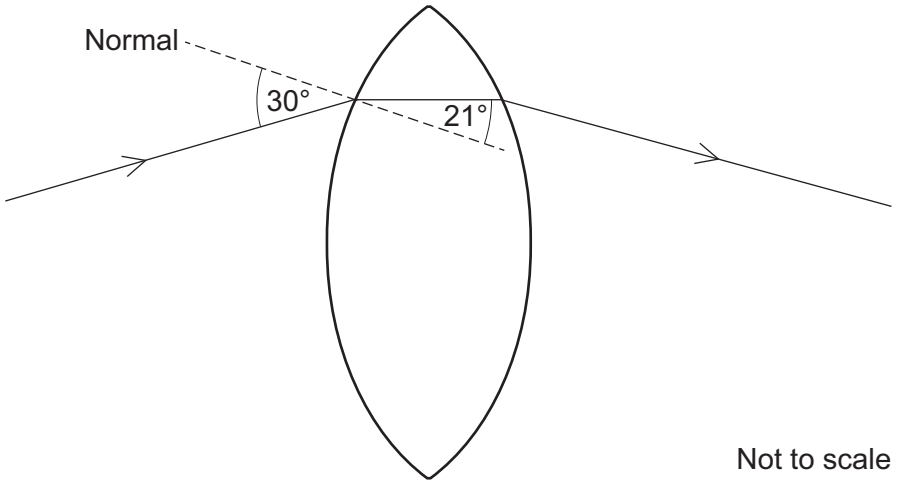
Focal length = ... metres

Question 5 continues on the next page

Do not write outside the box

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

Figure 8



Not to scale

5 (d) (i) 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 (d) (ii) Different lenses of the same power can be made using glass of a different refractive index.

State **one** advantage of making spectacles using lenses made from glass of a higher refractive index.

[1 mark]

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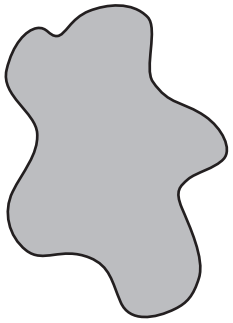
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10

Do not write outside the box

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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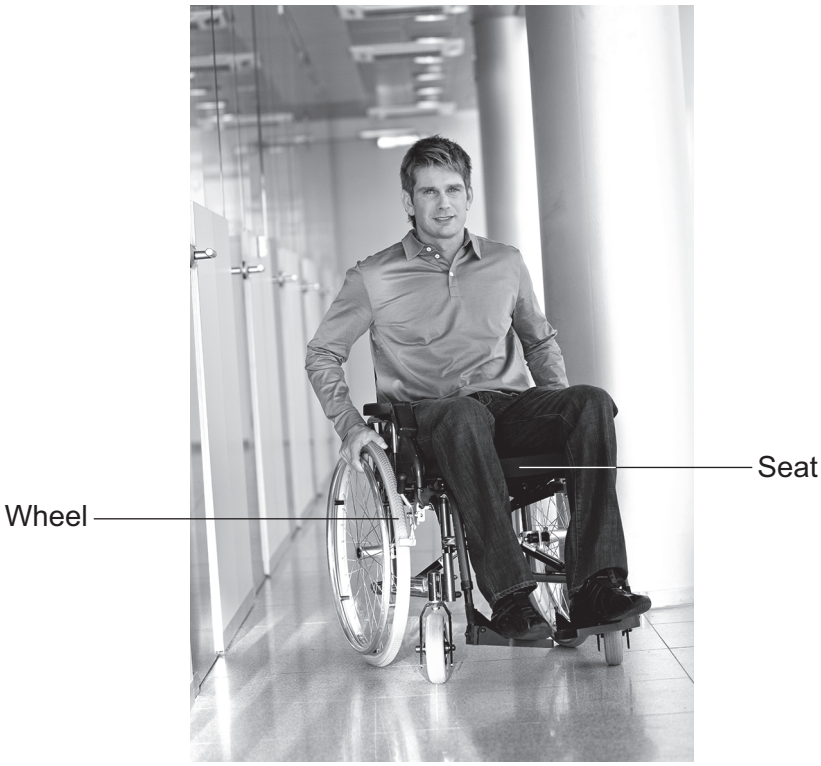
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Question 6 continues on the next page

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

Figure 10



Do not write outside the box

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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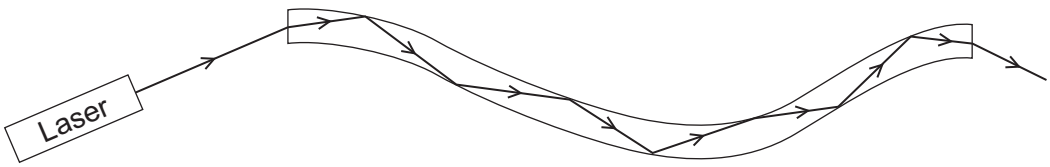
9

Turn over for the next question

Do not write outside the box

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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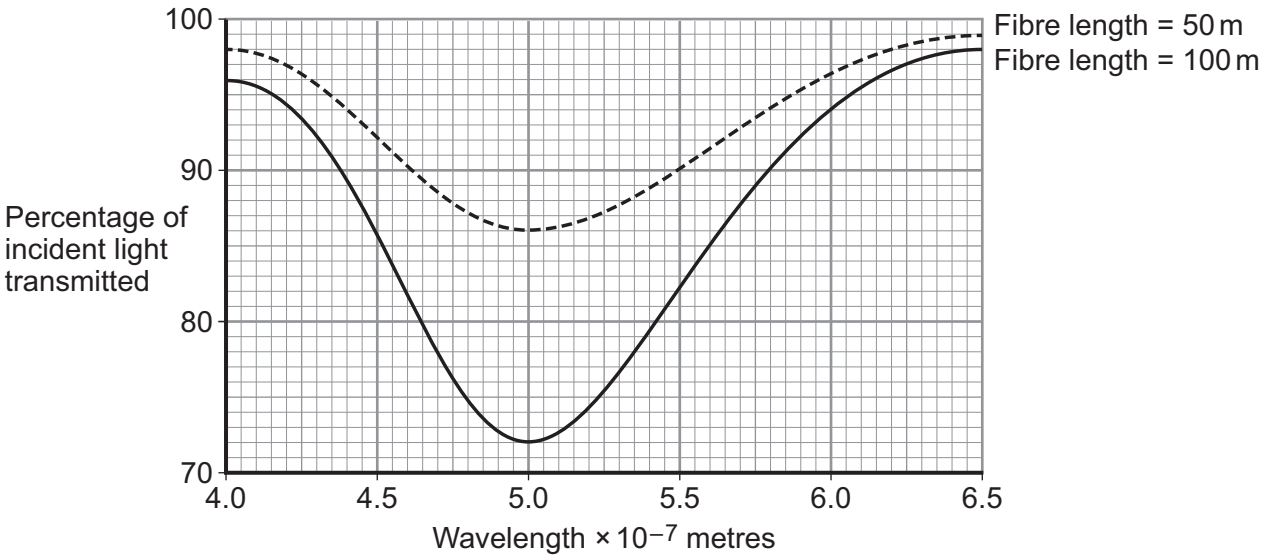
Critical angle = ... degrees

Do not write outside the box

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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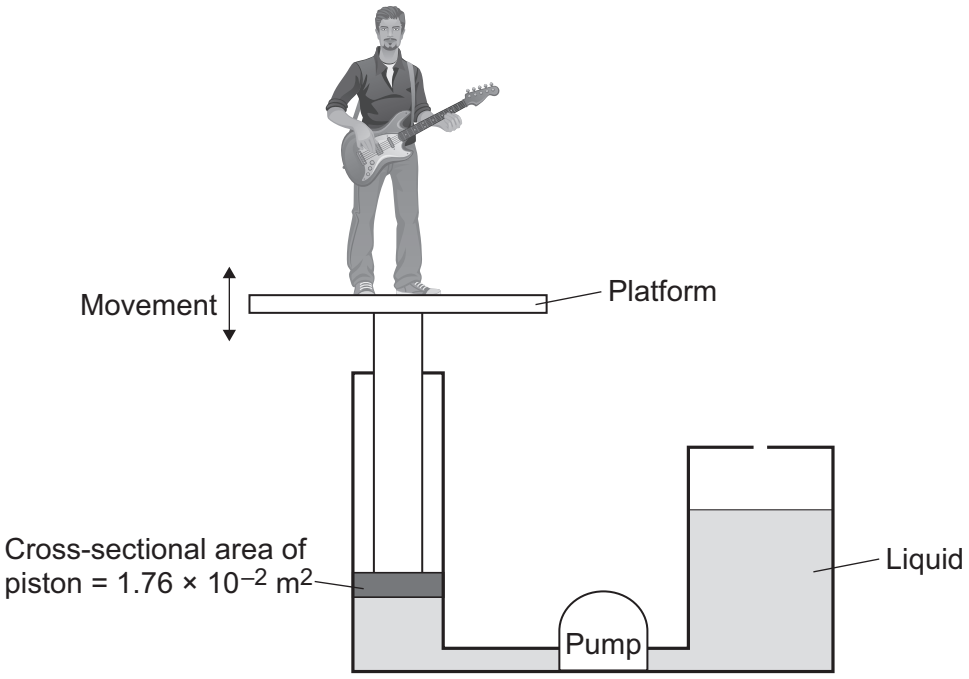
6

Do not write outside the box

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]

.....

8 (b) The pump creates a pressure in the liquid of 8.75 x 10^4 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

Do not write outside the box

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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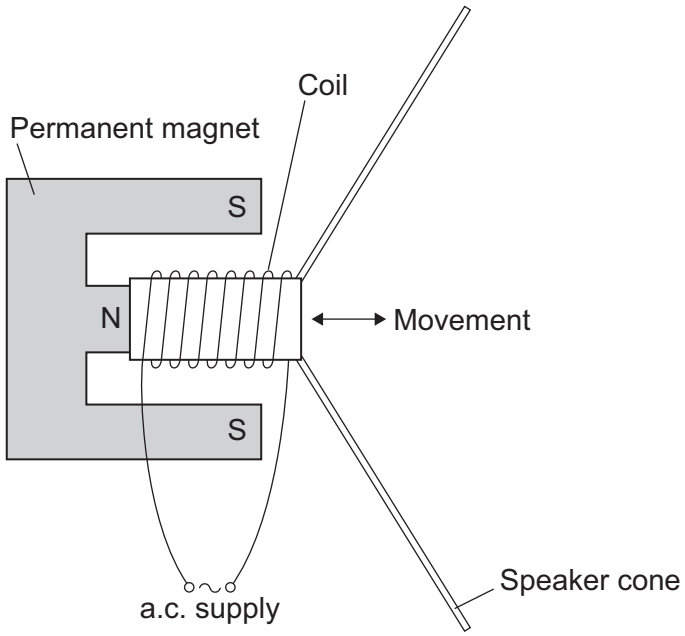
Question 8 continues on the next page

Do not write outside the box

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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8

END OF QUESTIONS

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GCSE
PHYSICS

PH3HP
Mark scheme

4403
June 2014

Version: 1.0 Final

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Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from aqa.org.uk

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Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

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Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a candidate writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

Quality of Written Communication and levels marking

In Question 3(a) candidates are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Candidates will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

Question	Answers	Extra information	Mark	AO spec ref
1(a)	(sound waves) which have a frequency higher than the upper limit of hearing for humans **or** a (sound) wave (of frequency) above 20 000 Hz	sound waves that cannot be heard is insufficient a wave of frequency 20 000 Hz is insufficient	1	AO1 3.1.2a
1(b)	640	an answer of 1280 gains **2** marks allow **2** marks for the correct substitution ie 1600 × 0.40 provided no subsequent step allow **2** marks for the substitution $\frac{1600 \times 0.80}{2}$ provided no subsequent step allow **1** mark for the substitution 1600 × 0.80 provided no subsequent step allow **1** mark for the identification that time (boat to bed) is 0.4	3	AO2 3.1.2c
1(c)	any **one** from: • pre-natal scanning / imaging • imaging of a named organ (that is not surrounded by bone), eg stomach, bladder, testicles • Doppler scanning blood flow	accept heart do **not** allow brain **or** lungs (either of these negates a correct answer)	1	AO1 3.1.2d

Question 1 continues on the next page . . .

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Question 1 continued . . .

Question	Answers	Extra information	Mark	AO spec ref
1(d)	advantage any **one** from: • (images are) high quality or detailed or high resolution • (scan) produces a slice through the body • image can be viewed from any direction • an image can be made of <u>any</u> part (inside the body) • easier to diagnose **or** see a problem (on the image) disadvantage any **one** from: • (the X-rays used **or** scans) are ionising • mutate cells **or** cause mutations **or** increase chances of mutations • turn cells cancerous **or** produce abnormal growths **or** produce rapidly growing cells • kill cells • metal/lead/glass/concrete shielding is needed	clearer / better image is sufficient allow images are (always) 3D / 360° allow whole body can be scanned allow a description of what ionising is allow for cells: DNA / genes / chromosomes / nucleus / tissue damage cells is insufficient can be dangerous (to human health) unqualified, is insufficient	1 1	AO1 3.1
Total			**7**	

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Question	Answers	Extra information	Mark	AO spec ref
2(a)	gravitational attraction (between the satellite and the Earth)	allow gravity allow weight of the satellite	1	AO1 3.2.4b
2(b)	any **two** from: • mass of satellite • speed / velocity (of satellite) • radius of orbit / circle	allow height above the Earth radius / height alone is insufficient	2	AO1 3.2.4c
2(c)(i)	increasing the height (above the Earth's surface) increases the time (for one orbit)	allow a positive correlation allow as one gets bigger, the other gets bigger, or vice versa ignore they are directly proportional	1	AO3 4.5.3
2(c)(ii)	there is no relationship / correlation		1	AO3 4.5.3
2(d)	Isaac Newton was a respected scientist who had made new discoveries before		1	AO3 3.2.4, SALoSE
Total			**6**	

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Question	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking.		Mark	AO spec ref
3(a)			6	
0 marks	**Level 1 (1–2 marks)**	**Level 2 (3–4 marks)**	**Level 3 (5–6 marks)**	AO1 3.3.2
No relevant / correct content.	**Either** there is an attempt at a description of the construction of a transformer **or** a correct statement of the effect of one type of transformer on the input p.d.	There is a description of the construction of a transformer **and** a correct statement of the effect of one type of transformer on the input p.d.	There is a clear description of the construction of a transformer **and** there is a correct description of how transformers affect the input p.d.	

details of construction:	extra information
a (laminated) core	
core is made from a magnetic material / iron	
2 coils	
the coils are made from an electrical conductor / copper	
the coils are covered in plastic / insulation	
the coils are (usually) on opposite sides	
step-up transformer has more turns on secondary coil than (its) primary (or vice versa)	
step-down transformer has less turns on secondary coil than (its) primary (or vice versa)	
effect on input p.d. :	
step-up transformer, the output p.d. is greater (than the input p.d.)	accept voltage for p.d.
step-down transformer, the output p.d. is lower (than the input p.d.)	

Question 3 continues on the next page . . .

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Question 3 continued . . .

Question	Answers	Extra information	Mark	AO spec ref
3(b)	switch mode (transformer)		1	AO1 3.3.2j
Total			**7**	

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Question	Answers	Extra information	Mark	AO spec ref
4(a)	3800	allow **1** mark for 2000 allow **1** mark for 1800 if neither of above scored, allow correct substitution for **1** mark (800 × 2.5) + (600 × 3) if moments have been calculated incorrectly, allow **1** mark for adding their two moment values correctly	3	AO1 AO2 3.2.2b
	newton metres **or** Nm	do **not** allow nm **or** NM	1	
4(b)	as the girl increases her distance (from the pivot) the clockwise moment increases		1	AO3 3.2.2b, c
	(F must increase) as the anticlockwise moment must increase		1	
	so (the anticlockwise moment) is equalled / balanced by the clockwise moment **or** so resultant / overall moment (on the board) is zero	accept to balance / equal the moments to balance the board is insufficient	1	
Total			**7**	

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Question	Answers	Extra information	Mark	AO spec ref
5(a)	CCD / charged coupled device pupil	ignore sensor do **not** allow film do **not** allow iris	1 1	AO1 3.1.4d
5(b)	the eye(ball) being too short the (eye) lens being unable to focus (an image at the retina) **or** the (ciliary) muscles being unable to change the shape of the lens sufficiently	 accept cornea / lens is not curved enough accept lens is not powerful enough **or** too weak accept lens being unable to accommodate	1 1	AO1 3.1.4b
5(c)	0.31(25)	allow **1** mark for correct substitution, ie $\frac{1}{3.2}$	2	AO2 3.1.4c
5(d)(i)	1.4	allow **2** marks for $\frac{0.5}{0.358}$ allow **2** marks for 1.39 an answer of 0.72 gains **2** marks allow **1** mark for correct substitution, ie $\frac{\sin 30°}{\sin 21°}$ allow **1** mark for both sine values correctly calculated ie 0.5 and 0.358 ignore any units	3	AO2 3.1.3c

Question 5 continues on the next page . . .

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Question 5 continued . . .

Question	Answers	Extra information	Mark	AO spec ref
5(d)(ii)	the lenses can be made thinner	allow the lenses / spectacles/ glasses are lighter allow uses less glass	1	
Total			**10**	

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Question	Answers	Extra information	Mark	AO spec ref
6(a)	suspend shape from a point / pivot / pin	can be shown on labelled diagram	1	AO1 3.2.1a
	attach pendulum (bob) / plumb line to point of suspension		1	
	draw (vertical) line on card where string rests		1	
	suspend card from another point and draw (a second vertical) line on card where string rests		1	
	where two lines cross = centre of mass		1	
		alternative method max **3** marks: balance card on a point (1) find point where card rests horizontally (1) this point is the centre of mass (1)		
6(b)(i)	(the line of action of) the weight acts/lies outside the base	reference to centre of mass unqualified is insufficient	1	AO1 3.2.2f
		references to stability insufficient		
	there will be a resultant moment		1	

Question 6 continues on the next page . . .

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Question 6 continued . . .

Question	Answers	Extra information	Mark	AO spec ref
6(b)(ii)	move the wheels further apart	answers must be comparative to diagram accept any method that would give a wider base accept tilt the wheels accept on own, make a wider base but not wider seat	1	AO2 3.2
	lower the seating position	accept any method that would lower the centre of mass, eg place heavy mass under the chair accept on own make it have a lower centre of mass make wheelchair heavier on its own is insufficient	1	
Total			**9**	

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Question	Answers	Extra information	Mark	AO spec ref
7(a)	because the angle of incidence is greater than critical angle	accept the light is totally internally reflected	1	AO1 3.1.5a
7(b)	41.8	allow **1** mark for correct substitution, eg $1.5 = \frac{1}{\sin c}$ **or** $\sin c = \frac{1}{1.5}$ **or** $c = \sin^{-1}\frac{1}{1.5}$	2	AO2 3.1.5a
7(c)	(for both fibres) increasing the <u>wavelength</u> of light decreases and then increases the percentage / amount of light transmitted	accept for **1** mark: (for both fibres) increasing the <u>wavelength</u> (of light) to 5 (x 10^{-7} metres), decreases the (percentage) transmission	1	AO3 4.5.3
	(for both fibres) the minimum transmission happens at 5 (x 10^{-7} metres) **or** maximum transmission occurs at 6.5 (x 10^{-7} metres)	accept for a further **1** mark: (for both fibres) increasing the <u>wavelength</u> of the light from 5 (x 10^{-7} metres) increases the amount of light transmitted increasing <u>wavelength</u> (of light), decreases the percentage transmitted is insufficient on its own	1	
	the shorter fibre transmits a greater percentage of light (at the same wavelength)	accept for **1** mark: Any statement that correctly processes data to compare the fibres	1	
Total			**6**	

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Question	Answers	Extra information	Mark	AO spec ref
8(a)	(a) hydraulic (system)		1	AO1 3.2.3b
8(b)	15.40 $\times 10^2$ **or** 1540	allow **1** mark for correct substitution, ie $8.75 \times 10^4 = \frac{F}{1.76 \times 10^{-2}}$ **or** $87\,500 = \frac{F}{0.0176}$ **or** $F = 8.75 \times 10^4 \times 1.76 \times 10^{-2}$ **or** $F = 87\,500 \times 0.0176$	2	AO2 3.2.3
8(c)	any **one** environmental **advantage**: plant oil is renewable using plant oil will conserve (limited) supplies **or** extend lifetime of the usual/crude oil. plant oil releases less carbon dioxide (when it is being produced / processed) plant oil will add less carbon dioxide to the atmosphere (when it is being produced / processed, than the usual oil) plant oil removes carbon dioxide from **or** adds oxygen to the air when it is growing	stating a converse statement is insufficient, or a disadvantage of the usual oil, ie the usual oil is non-renewable stating that plant oil is carbon neutral is insufficient	1	AO2 3.2.3c

Question 8 continues on the next page . . .

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Question 8 continued . . .

Question	Answers	Extra information	Mark	AO spec ref
8(d)	(the current flowing through the coil) creates a magnetic field (around the coil)		1	AO2 AO3 3.3.1a, b
	(this magnetic field) interacts with the permanent magnetic field **or** current carrying conductor is in a (permanent) magnetic field	it must be clear which magnetic field is which	1	
	this produces a (resultant) force (and coil / cone moves)		1	
	when the direction of the current changes, the direction of the force changes to the opposite direction		1	
		accept for **2** marks the magnetic field of the coil interacts with the permanent magnetic field		
Total			**8**	

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

General Certificate of Secondary Education
Higher Tier
June 2013

Physics

Unit Physics P3

PH3HP

H

Thursday 23 May 2013 9.00 am to 10.00 am

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.

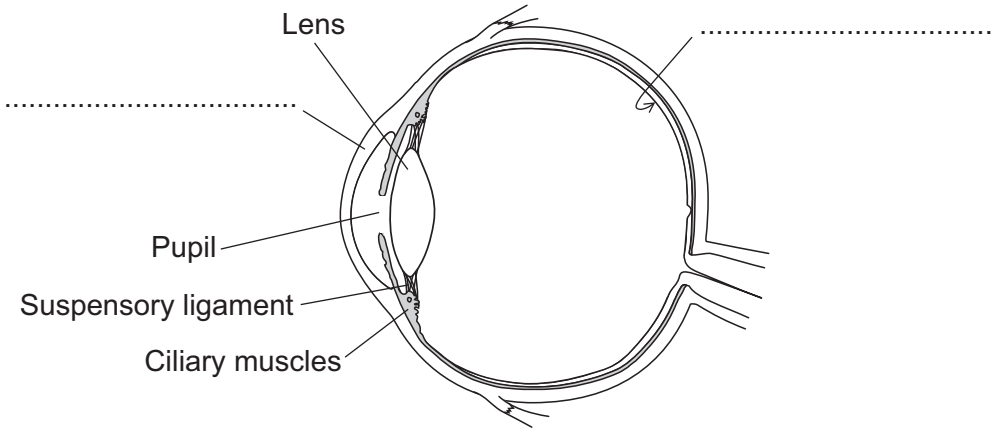
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Do not write outside the box

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

1 (a) The diagram shows parts of the human eye.

Complete the missing labels.



(2 marks)

1 (b) Each part of the human eye has a function.

Complete the table below.

Part of the human eye	Function of the part
.....	Changes size to make sure the correct amount of light enters the eye.
Ciliary muscles	....
Lens	....

(3 marks)

Do not write outside the box

1 (c) The human eye can focus on near objects. The closest distance the eye can bring into sharp focus is called the near point.

A student measured the near point of four people of different ages. The table shows her data.

Age of human in years	Near point in millimetres
10	200
25	250
40	400
55	700

What can you conclude from the data in the table above?

.....

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.....

.....

(2 marks)

1 (d) Suggest how the data obtained by the student could be improved.

.....

.....

(1 mark)

1 (e) Spectacles are worn to correct vision. One of the lenses in a pair of spectacles has a focal length of 40 centimetres.

Calculate the power of the lens.

Use the correct equation from the Physics Equations Sheet.

.....

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.....

Power of lens = ... dioptres

(2 marks)

10

Turn over ▶

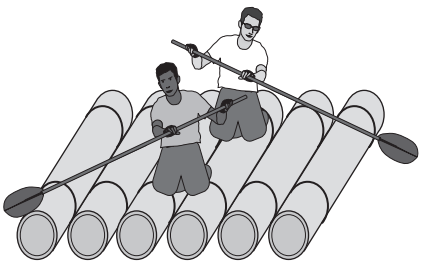
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2 An event involved paddling a homemade raft down a fast-flowing river. The rafts were made using empty barrels.

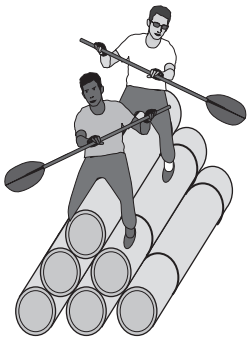


Below are the designs of two rafts.

Design **A**



Design **B**



2 (a) Compare the stability of the two raft designs. Give reasons for your answer.

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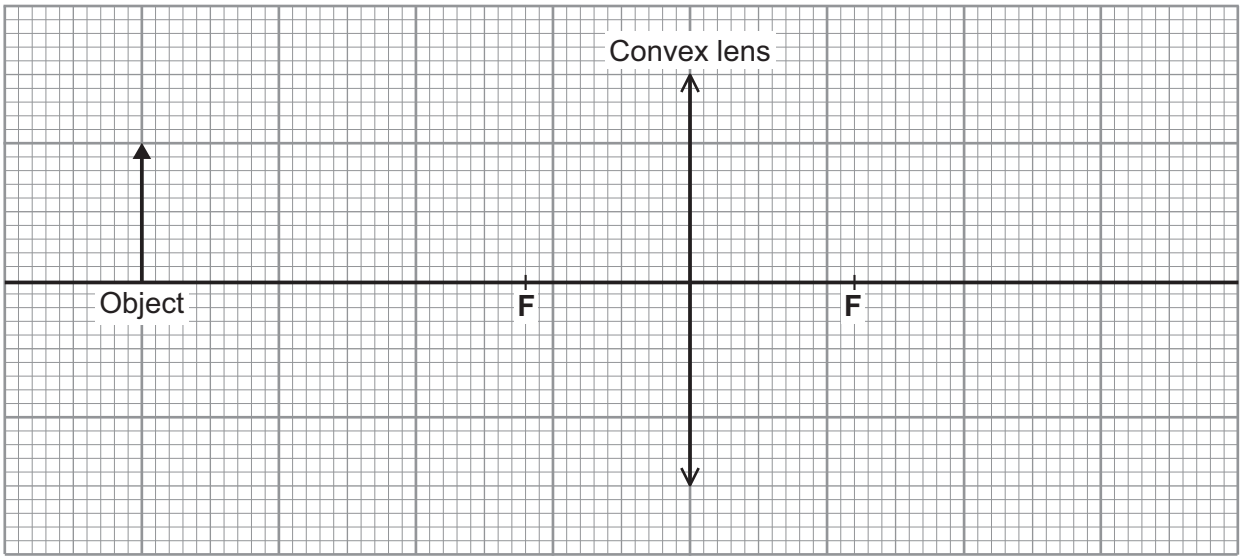
.....

(2 marks)

Do not write outside the box

2 (b) A camera was used to take photographs of the rafts. The camera contains a convex (converging) lens.

Complete the ray diagram to show how the lens produces an image of the object.



F = Principal focus

(4 marks)

2 (c) State **two** words to describe the nature of the image produced by the lens in the camera.

1 .....

2 .....

(2 marks)

8

Turn over for the next question

Do not write outside the box

3 Ultrasound and X-rays are waves used in hospitals to create images of the inside of the human body. To produce the images below, the waves must enter the human body.

Ultrasound scan of an unborn child



X-ray of a broken bone



3 (a) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Describe the features of ultrasound and X-rays, and what happens to each type of wave after it has entered the human body.

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(6 marks)

Do not write outside the box

3 (b) It would **not** be safe to use X-rays to produce an image of an unborn child.

Explain why.

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(2 marks)

3 (c) Ultrasound can be used for medical treatments as well as for imaging.

Give **one** use of ultrasound for medical treatment.

.....

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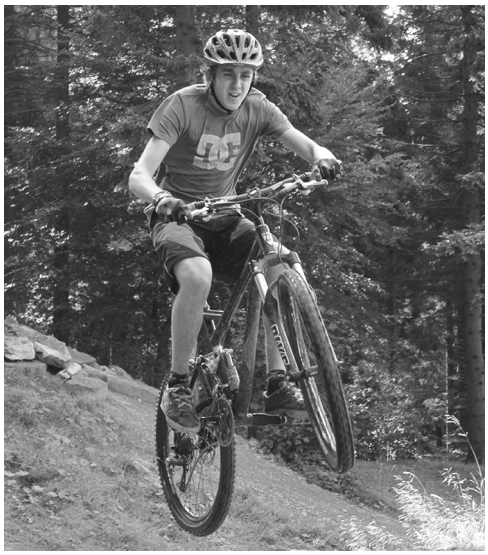
(1 mark)

9

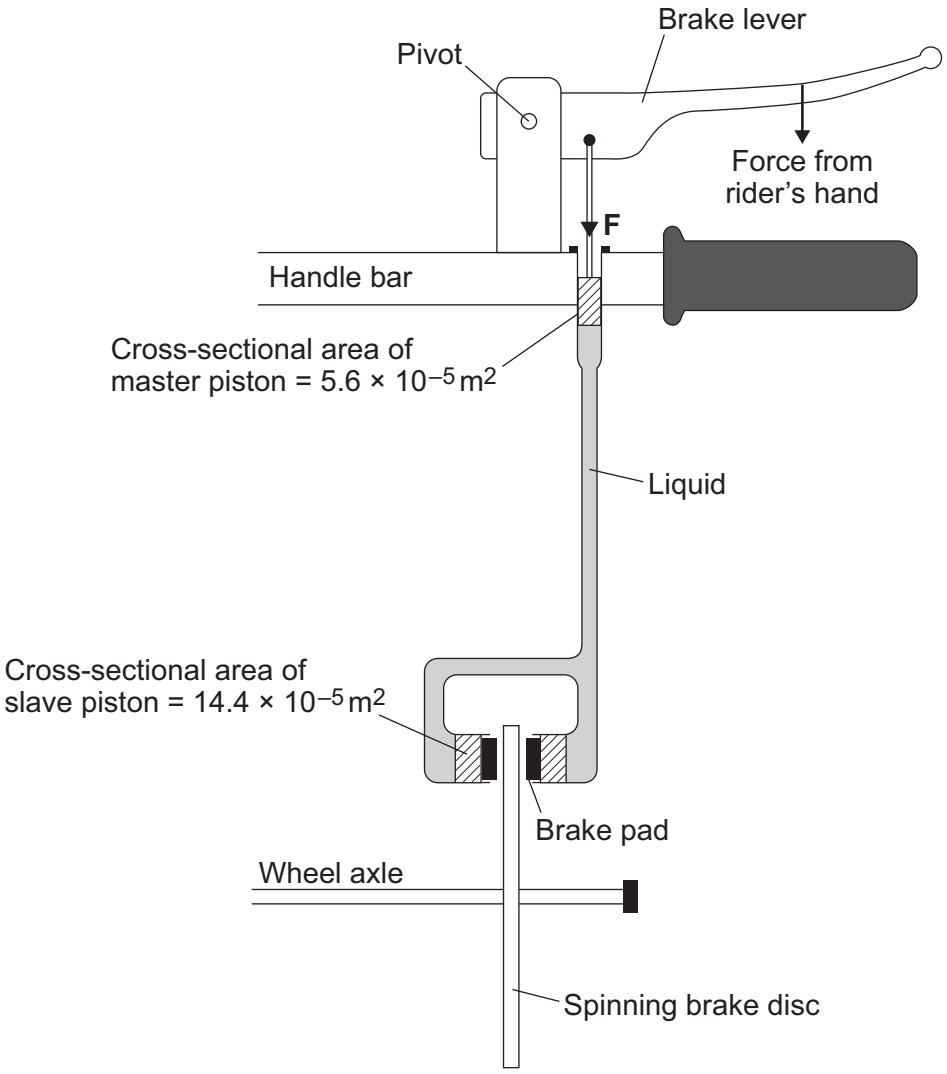
Turn over for the next question

Do not write outside the box

4 Mountain bike riders use brakes to slow down.



Some mountain bikes have hydraulic brakes.



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Do not write outside the box

4 (a) What property of a liquid enables a hydraulic brake system to work?

.....

(1 mark)

4 (b) When the rider's hand pulls on the brake lever, the master piston applies a pressure of 1.5×10^6 pascals to the liquid.

Using information from the diagram, calculate the force **F** exerted on the liquid by the master piston.

Use the correct equation from the Physics Equations Sheet.

.....

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.....

.....

Force **F** = ... N

(2 marks)

4 (c) The pressure in the liquid applies a force to move each slave piston.

How does the size of this force compare to the force **F** applied by the master piston?

.....

.....

Give a reason for your answer.

.....

.....

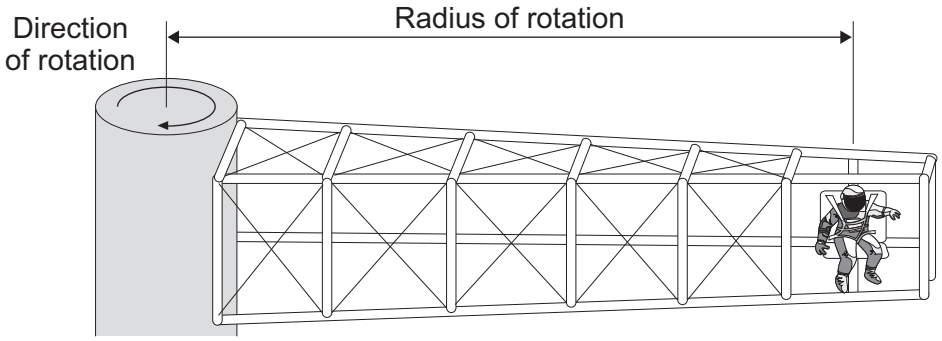
(2 marks)

5

Turn over for the next question

Do not write outside the box

5 The diagram shows a 'G-machine'. The G-machine is used in astronaut training.



The G-machine moves the astronaut in a horizontal circle.

5 (a) When the G-machine is rotating at constant speed, the astronaut is accelerating.

State the name and direction of the force causing the astronaut to accelerate.

Name of force .....

Direction of force .....

.....

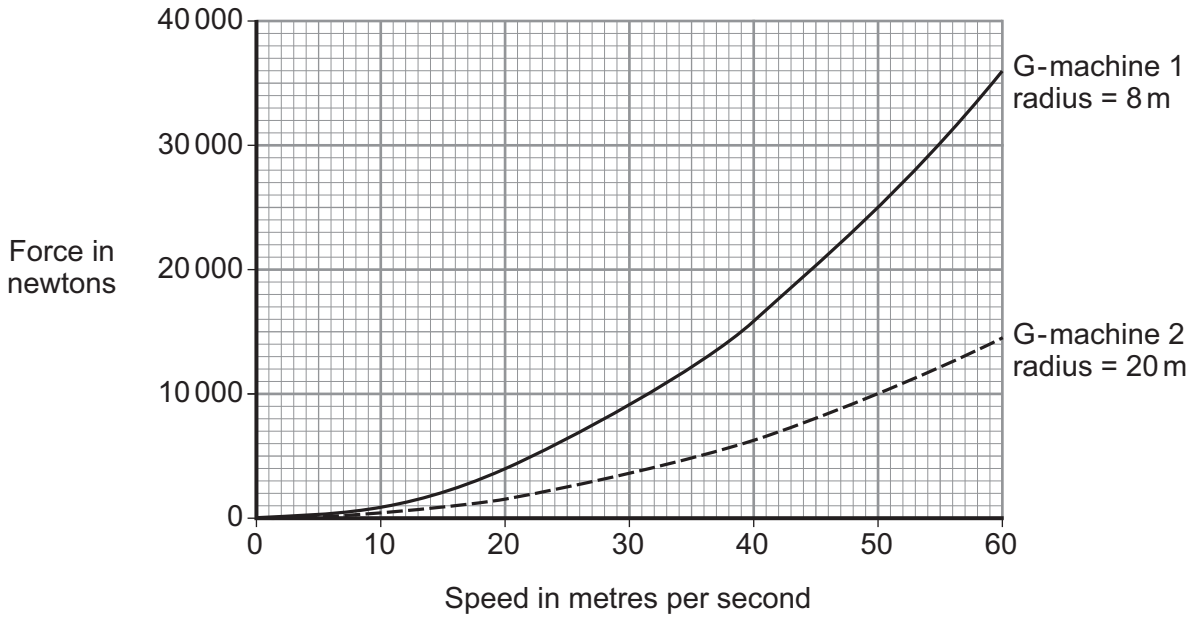
(2 marks)

Do not write outside the box

5 (b) The force causing the astronaut to move in a circle is measured.

The graph shows how the speed of the astronaut affects the force causing the astronaut to move in a circle for two different G-machines.

The radius of rotation of the astronaut is different for each G-machine.



5 (b) (i) State **three** conclusions that can be made from the graph.

1 .....

.....

2 .....

.....

3 .....

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(3 marks)

5 (b) (ii) The speed of rotation of G-machine 1 is increased from 20 m/s to 40 m/s.

Determine the change in force on the astronaut.

.....

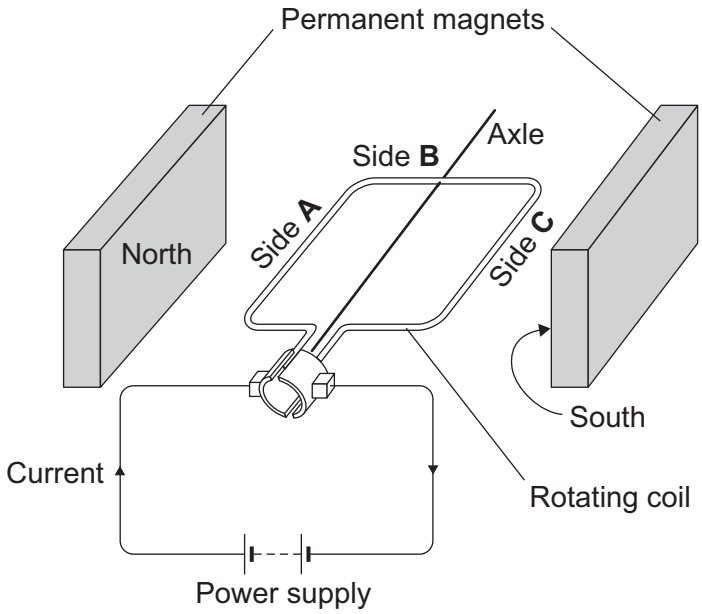
Change in force = ... N

(1 mark)

Turn over ▶

Do not write outside the box

5 (c) Each G-machine is rotated by an electric motor. The diagram shows a simple electric motor.



5 (c) (i) A current flows through the coil of the motor.

Explain why side **A** of the coil experiences a force.

.....

.....

.....

.....

(2 marks)

5 (c) (ii) Draw arrows on the diagram to show the direction of the forces acting on side **A** of the coil and side **C** of the coil.

(1 mark)

5 (c) (iii) When horizontal, side **B** experiences no force.

Give the reason why.

.....

.....

(1 mark)

Do not write outside the box

5 (d) While a G-machine is rotating, the operators want to increase its speed.

What can the operators do to make the G-machine rotate faster?

.....

.....

(1 mark)

5 (e) The exploration of space has cost a lot of money.

Do you think spending lots of money on space exploration has been a good thing?

Draw a ring around your answer.

Yes **No**

Give a reason for your answer.

.....

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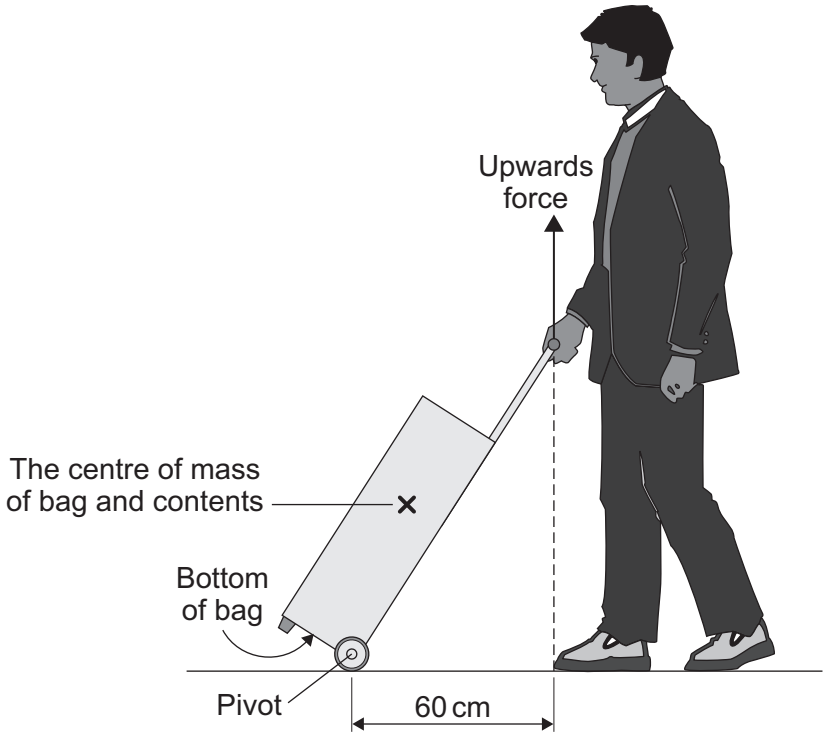
(1 mark)

12

Turn over for the next question

Do not write outside the box

6 The diagram shows a man standing in an airport queue with his wheeled bag.



6 (a) The man applies an upward force to the handle of his bag to stop the bag from falling. The moment of this force about the pivot is 36 Nm.

Calculate the upward force the man applies to the handle of his bag.

Use the correct equation from the Physics Equations Sheet.

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Force = ... N

(2 marks)

Do not write outside the box

6 (b) When the man lets go of the bag handle, the bag falls and hits the floor.

Explain why.

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(2 marks)

6 (c) During his holiday the man visits the Foucault Pendulum in Paris, France.
The pendulum makes 10 complete swings every 160 seconds.

Calculate the frequency of the pendulum and give the unit.

Use the correct equation from the Physics Equations Sheet.

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Frequency = ...

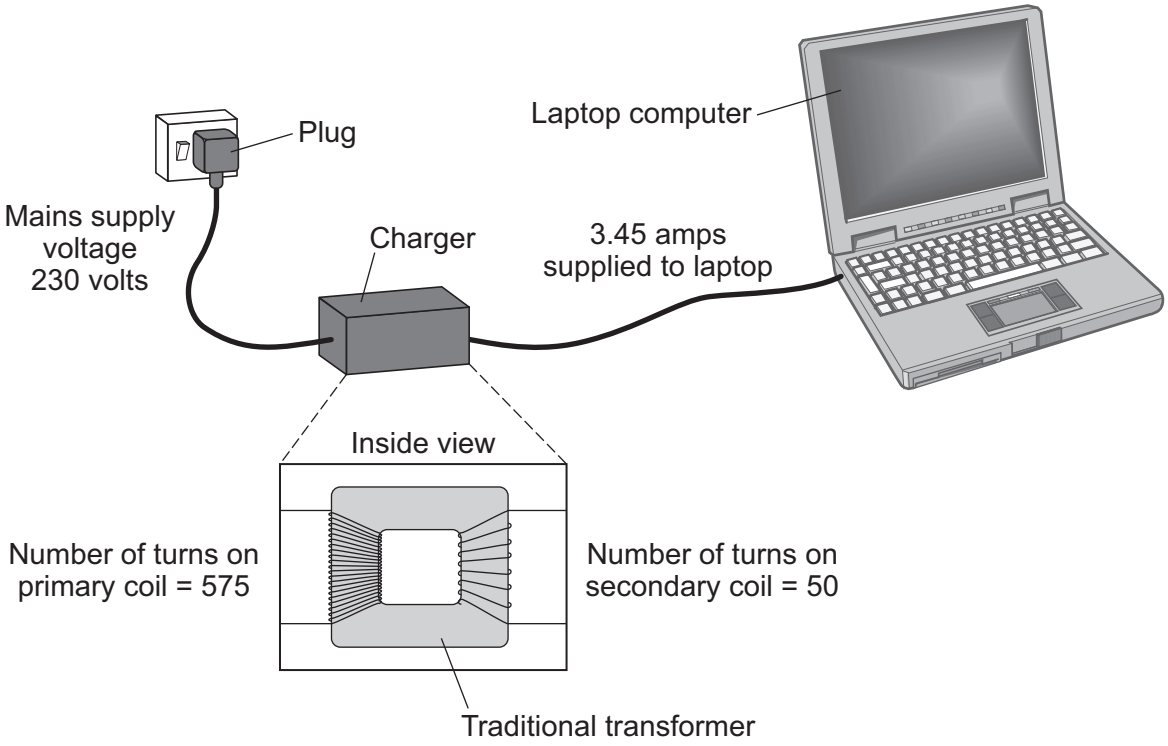
(3 marks)

7

Turn over for the next question

Do not write outside the box

7 Batteries inside laptop computers are charged using laptop chargers. The laptop charger contains a traditional transformer.



7 (a) The alternating current flowing through the primary coil of the transformer creates an alternating current in the secondary coil.

Explain how.

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(3 marks)

Do not write outside the box

7 (b) (i) Use information from the diagram to calculate the potential difference the charger supplies to the laptop.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

.....

Potential difference = ... V

(2 marks)

7 (b) (ii) Calculate the current in the primary coil of the transformer when the laptop is being charged.

Assume the transformer is 100% efficient.

Use the correct equation from the Physics Equations Sheet.

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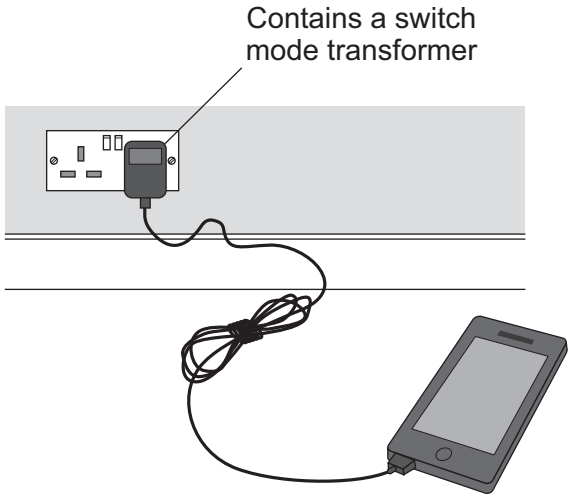
Current = ... A

(2 marks)

Question 7 continues on the next page

Do not write outside the box

7 (c) Switch mode transformers can be used in mobile phone chargers.



Switch mode transformers and traditional transformers can both use the UK mains supply.

The switch mode transformer is smaller and lighter than the traditional transformer used in the laptop charger.

Give **one** other advantage of the switch mode transformer.

.....

.....

(1 mark)

7 (d) Laptop batteries and mobile phone batteries can only be recharged a limited number of times. After this, the batteries cannot store enough charge to be useful. Scientists are developing new batteries that can be recharged many more times than existing batteries.

Suggest **one** other advantage of developing these new batteries.

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(1 mark)

9

END OF QUESTIONS

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There are no questions printed on this page

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Version 1.0



General Certificate of Secondary Education
June 2013

Physics PH3HP

(Specification 4403)

Unit: Physics 3

Final

Mark Scheme

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

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Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a candidate writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

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Quality of Written Communication and levels marking

In Question 3(a) candidates are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Candidates will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

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Question 1

question	answers	extra information	mark
1(a)	cornea (LHS gap)	must be in correct space	1
	retina (RHS gap)		1
1(b)	iris **or** pupil		1
	to change the shape / curvature (of the surface) of the lens	accept to make the lens thinner / fatter to contract and relax is insufficient	1
	to focus the light (from the object, onto the retina)	accept to refract / change direction of light accept rays for light accept to form / focus an image (on the retina) to focus is insufficient	1
1(c)	the older (a human), the longer the near point (or vice versa) **or** young people have the shortest near point (or vice versa)	answer must be in terms of near point (or a description of), eg become increasingly long sighted as you get older allow near point increases with age do **not** accept eye sight deteriorates as you get older answers must be comparative	1
	the (rate of) change of the near point increases as you get older (or vice versa)	accept near point increases most rapidly after 40 this statement alone gains **2** marks: the (rate of) increase of the near point gets greater as you get older	1

Question 1 continues on the next page . . .

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PH3HP

Question 1 continued . . .

question	answers	extra information	mark
1(d)	test / measure / use more people (to increase the range of ages) **or** test / measure / use more people with ages in between (those already measured)	accept test older / younger people accept increase sample size repeat the measurements (of the same people) is insufficient	1
1(e)	2.5	allow **1** mark for correct substitution and conversion to metres, ie $\frac{1}{0.4}$ provided no subsequent step shown an answer of 0.025 gains **1** mark	2
Total			**10**

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PH3HP

Question 2

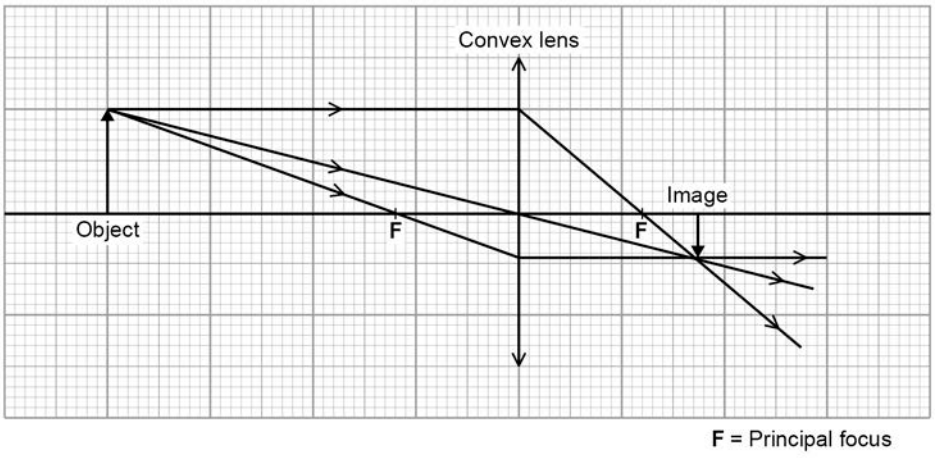
question	answers	extra information	mark
2(a)	raft A is more stable	no mark for identifying raft, marks for explanation	
	raft A has the lower <u>centre of gravity / mass</u>	must be direct / implied comparison to the other raft	1
	raft A has the wider base / is the widest **OR** raft B is less stable raft B has the higher <u>centre of gravity / mass</u> (1) raft B has the narrower base / is the widest (1)	accept the barrels are spread out the most **or** the base / surface area is the largest if wrong or no raft identified as being most / least stable, **1** mark maximum for BOTH correct explanations of C of G & base width	1

Question 2 continues on the next page . . .

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Question 2 continued . . .

question	answers	extra information	mark
2(b)	any **two** correct construction lines: • line passing straight through centre of lens (& out other side) • line travelling parallel to principal axis & then being refracted through principal focus (on RHS) • line travelling through principal focus (on LHS) & then being refracted to be parallel to principal axis (on RHS)	if more than 2 construction lines treat as a list	2
	<u>inverted</u> image drawn (with arrow) in correct location		1
	one arrowhead from object to image on any construction ray	conflicting arrowheads negate this mark	1
			
2(c)	any **two** from: • inverted • real • diminished / smaller	accept upside down allow ecf if ray diagram wrongly drawn but descriptions must relate to **their image** a converse negates mark, eg real and virtual scores zero	2
Total			**8**

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Question 3

question	answers	extra information	mark
3(a)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking.		6

0 marks	**Level 1 (1–2 marks)**	**Level 2 (3–4 marks)**	**Level 3 (5–6 marks)**
No relevant / correct content.	There is a basic description of either wave **OR** What happens to either wave when they enter the body. However there is little other detail.	There is either: A clear description of BOTH waves **OR** A clear description as to what happens to BOTH waves inside the body **OR** A clear description of ONE of the waves with clear detail as to what happens to either wave inside the body.	There is a detailed description of BOTH of the waves **AND** A detailed description as to what happens to EITHER wave inside the body.

Question 3 continues on the next page . . .

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Question 3 continued . . .

Examples of the points made in the response:		
Description of an X-ray • X-rays are electromagnetic waves / part of the electromagnetic spectrum • X-rays are (very) high frequency (waves) • X-rays are (very) high energy (waves) • X-rays have a (very) short wavelength • Wavelength (of X-rays) is of a similar size to (the diameter of) an atom • X-rays are a transverse wave • X-rays are ionising radiation	do **not** allow a description of a property – eg X-rays travel through a vacuum / at the speed of light correct description acceptable – oscillations / vibrations are perpendicular (at 90°) to direction of energy transfer	
Description of ultrasound • ultrasound has a frequency above 20 000 (hertz) **OR** ultra sound is above 20 000 hertz • ultrasound is above / beyond the human (upper) limit (of hearing) • ultrasound is a longitudinal wave	accept ultrasound cannot be heard by humans correct description acceptable – oscillations / vibrations (of particles) are parallel (in same direction) to direction of energy transfer	
Statement(s) as to what happens to X-rays inside the human body: • X-rays are absorbed by bone • X-rays travel through / are transmitted by tissue / skin		
Statement as to what happens to ultrasound inside body: • ultrasound is (partially) reflected at / when it meets a boundary between two different media • travel at different speeds through different media		

Question 3 continues on the next page . . .

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Question 3 continued . . .

question	answers	extra information	mark
3(b)	(because the X-rays) are ionising	accept a description of what ionising is	1
	(they will) damage cells **or** mutate cells / cause mutations / increase chances of mutations **or** turn cells cancerous / produce abnormal growths / produce rapidly growing cells **or** kill cells	instead of cell, any of these words can be used: DNA / genes / chromosomes / nucleus do **not** accept they can be dangerous (to human health) do **not** accept damage to soft tissue	1
3(c)	any **one** from: • removal / destruction of kidney / gall stones		1
	• repair of damaged tissue / muscle	accept examples of repair, eg alleviating bruising, repair scar damage, ligament / tendon damage, joint inflammation accept physiotherapy accept curing prostate cancer **or** killing prostate cancer cells	
	• removing plaque from teeth	cleaning teeth is insufficient	
Total			**9**

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Question 4

question	answers	extra information	mark
4(a)	liquids are (virtually) incompressible		1
4(b)	84	allow **1** mark for correct substitution, ie $1.5 \times 10^6 = \frac{F}{5.6 \times 10^{-5}}$ numbers may not be written in standard form, ie $1\ 500\ 000 = \frac{F}{0.000\ 056}$ allow **1** mark for an answer 216	2
4(c)	it (the force on the slave pistons) is greater / larger	accept force (at slave piston) = 216 (N)	1
	the area (touching the liquid) of the slave piston is greater than the area of the master piston	accept it has a bigger area just quoting numbers, eg the master piston is 5×10^{-5} and the slave piston is 14.4×10^{-5} is insufficient	1
Total			**5**

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Question 5

question	answers	extra information	mark
5(a)	centripetal (force)	allow tension (between astronaut and seatbelt)	1
	towards the centre (of the G-machine / circle)	do **not** accept towards the centre of the Earth allow inwards	1
5(b)(i)		answers must be comparative accept velocity for speed	
	the greater the speed (of a centrifuge), the greater the force	accept positive correlation between speed and force speed and force are not proportional – treat as neutral	1
	the smaller the radius, the greater the force (at a given speed)	allow **(G machine) 1** has / produces a greater force (than **G machine 2**) at the same speed must be comparative, eg a small radius produces a large force = 0 marks on own	1
	as the speed increases the rate of change in force increases	accept force is proportional to the square of the speed **or** doubling speed, quadruples the force accept any clearly correct conclusion	1
5(b)(ii)	12000 (N) **or** 12 k(N)		1

Question 5 continues on the next page . . .

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Question 5 continued . . .

question	answers	extra information	mark
5(c)(i)	the current (in the coil) creates a magnetic field (around the coil) so the magnetic field of the coil interacts with the (permanent) magnetic field of the magnets (producing a force)	accept the coil is an electromagnet accept the two magnetic fields interact (producing a force) if no marks scored an answer in terms of current is perpendicular to the (permanent) magnetic field is worth max **1** mark	1 1
5(c)(ii)	vertically downwards arrow on side A **and** vertically upwards arrow on side C	one arrow insufficient	1
5(c)(iii)	the current is parallel to the magnetic field	allow the current and magnetic field are in the same direction allow it / the wire is parallel to the magnetic field	1
5(d)	increase the current / p.d. (of the coil)	accept decrease resistance accept voltage for p.d. accept increase strength of magnetic field / electromagnet	1

Question 5 continues on the next page . . .

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Question 5 continued . . .

question	answers	extra information	mark
5(e)	yes with suitable reason **or** no with suitable reason	**eg** **yes** – it has increased our knowledge **yes** – It has led to more (rapid) developments / discoveries (in technology / materials / transport) accept specific examples **no** – the money would have been better spent elsewhere on such things as hospitals (must quote where, other things not enough) **no** mark for just **yes** / **no** reason must match **yes** / **no**	1
Total			**12**

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Question 6

question	answers	extra information	mark
6(a)	60	allow **1** mark for correct substitution (with d in metres), ie 36 = F × 0.6 an answer of 0.6 **or** 6 gains **1** mark	2
6(b)	the line of action of the weight lies outside the base / bottom (of the bag)	accept line of action of the weight acts through the side accept the weight (of the bag) acts outside the base / bottom (of the bag)	1
	a resultant / overall / unbalanced moment acts (on the bag)	accept the bag is not in equilibrium do **not** accept the bag is unbalanced	1
6(c)	0.0625	allow **1** mark for correct substitution, ie $16 = \frac{1}{f}$ an answer of 0.00625 gains **1** mark	2
	hertz / Hz	do **not** accept HZ **or** hz	1
Total			**7**

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Question 7

question	answers	extra information	mark
7(a)	(the alternating current creates) a changing / alternating magnetic field		1
	(magnetic field) in the (iron) core	accept that links with the secondary coil current in the core negates this mark	1
	(causing a) potential difference (to be) induced in / across secondary coil	accept voltage for p.d.	1
7(b)(i)	20	allow **1** mark for correct substitution, ie $\frac{230}{V_s} = \frac{575}{50}$ **or** $\frac{V_s}{230} = \frac{50}{575}$	2

Question 7 continues on the next page . . .

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Question 7 continued . . .

question	answers	extra information	mark
7(b)(ii)	0.3 **or** correct calculation using $230 \times I_p$ = their (b)(i) × 3.45	allow **1** mark for correct substitution, ie $230 \times I_p = 20 \times 3.45$ allow ecf from (b)(i) for 20 **OR** substitution into this equation $\frac{I_p}{I_s} = \frac{N_s}{N_p}$	2
7(c)	(switch mode transformers) use (very) little power / current / energy when switched on but no load is applied **or** it is more efficient	accept no for little ignore it is more portable do **not** accept electricity for power / current / energy accept does not get as hot **or** less heat produced	1
7(d)	any **one** from: • fewer (waste) batteries have to be sent to / buried in land-fill • the soil is polluted less by batteries in land-fill • fewer (waste) batteries have to be recycled • fewer batteries have to be made • less raw materials are used in making batteries • customers have to replace their batteries less often • customers have to buy fewer (replacement) batteries	longer lifetime is insufficient it costs less is insufficient	1
Total			**9**

UMS Conversion Calculator: www.aqa.org.uk/umsconversion

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