AQA GCSE PHYSICS (4451)

PHYSICS



EXAM QUESTION PACK

UNIT P3 HIGHER TIER PHY3H PAPERS

STEMUP

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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 2012

Physics

PHY3H

Unit Physics P3

H

Written Paper

Wednesday 30 May 2012 1.30 pm to 2.15 pm

For this paper you must have:
- a ruler.

You may use a calculator.

Time allowed
- 45 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. 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 45.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

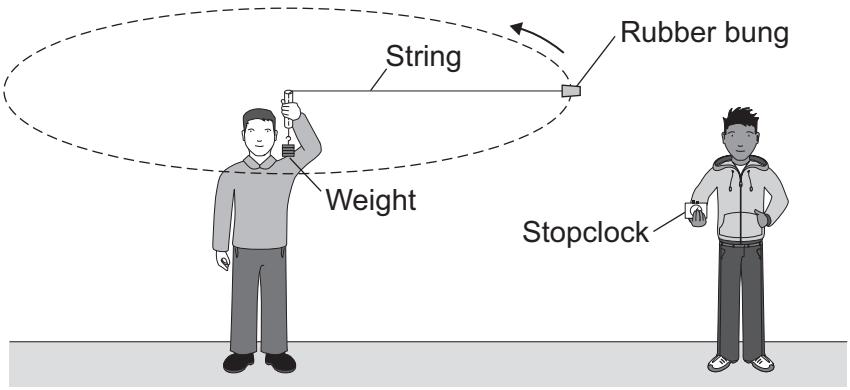
Advice
- In all calculations, show clearly how you work out your answer.

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

1 The diagram shows the apparatus used by two students to find out how the centripetal force acting on an object affects the speed of the object.



1 (a) (i) In which direction does the centripetal force act on the rubber bung?

.....

(1 mark)

1 (a) (ii) In this investigation, what provides the centripetal force?

.....

.....

(1 mark)

1 (b) One student swung the rubber bung around in a circle at constant speed. The second student timed how long it took the rubber bung to complete 10 rotations. The students then calculated the speed of the rubber bung, using the radius of the circle and the time to complete one rotation. The students repeated this for several different values of centripetal force.

1 (b) (i) During the investigation, the radius of the circle and the mass of the rubber bung were not changed.

Explain why.

.....

.....

.....

.....

(2 marks)

Do not write outside the box

1 (b) (ii) One of the variables in this investigation was the time taken by the rubber bung to complete 10 rotations.

Which **two** words can be used to describe this variable?

Draw a ring around each of your **two** answers.

continuous **control** **dependent** **independent**

(1 mark)

1 (b) (iii) The students timed 10 rotations of the rubber bung, rather than just one rotation.

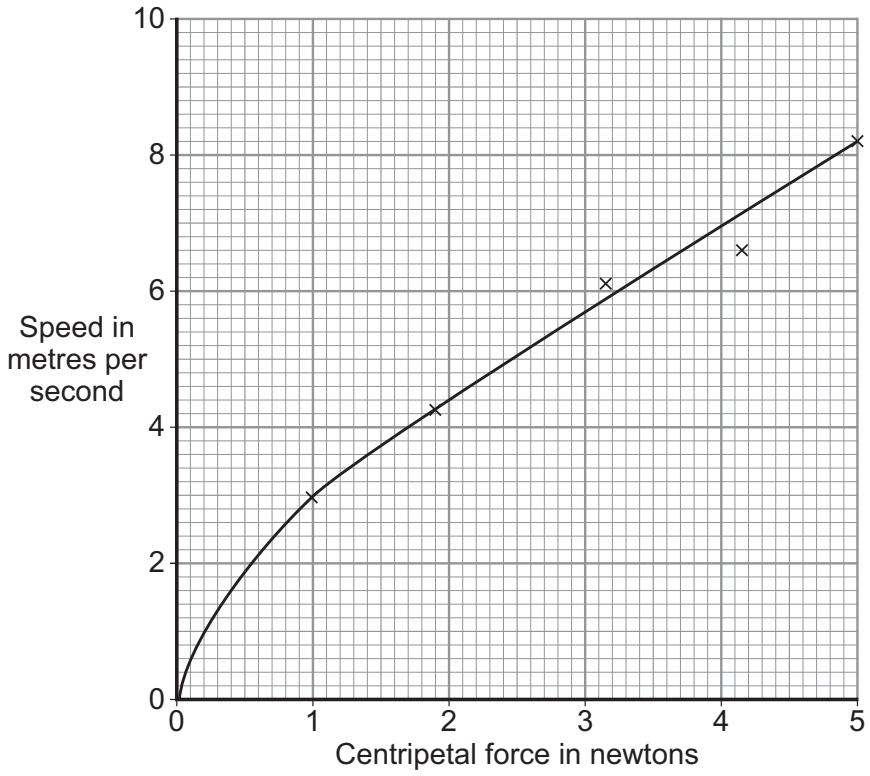
Suggest why.

.....

.....

(1 mark)

1 (c) The graph shows the students' data.



There is a relationship between the speed of an object moving in a circle and the centripetal force acting on the object.

What conclusion about this relationship can the students make from their data?

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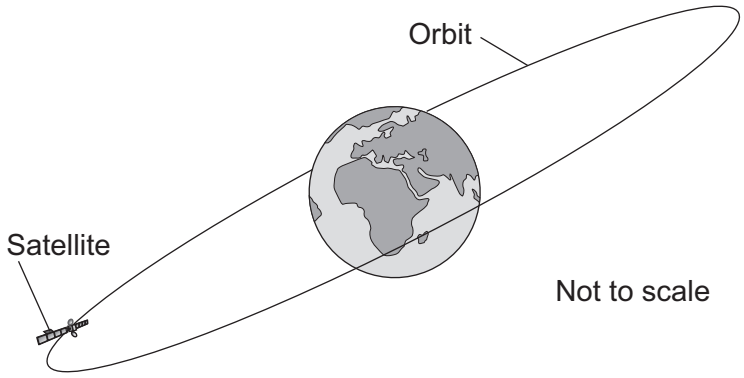
(1 mark)

Question 1 continues on the next page

Turn over ▶

Do not write outside the box

1 (d) The diagram shows a satellite in a circular orbit above the Earth.
The satellite is part of the global positioning system (GPS).
The satellite orbits the Earth **twice** every 24 hours.



1 (d) (i) What provides the centripetal force needed to keep the satellite in its orbit around the Earth?

.....

(1 mark)

1 (d) (ii) Is this satellite in a geostationary orbit?

Draw a ring around your answer. **Yes** **No**

Give a reason for your answer.

.....

.....

(1 mark)

9

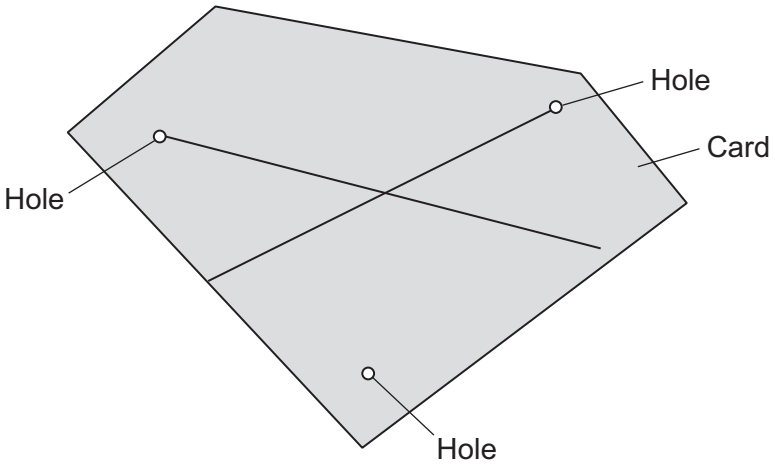
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ANSWER IN THE SPACES PROVIDED

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2 A student was asked to find the centre of mass of a thin sheet of card. The diagram shows the result of the student's experiment. The student drew two lines onto the card. The centre of mass is where the two lines cross.



2 (a) Describe how the student found the correct positions to draw the **two** lines. You may include a labelled diagram in your answer.

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(3 marks)

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2 (b) Explain how the student can check that the position found for the centre of mass is accurate.

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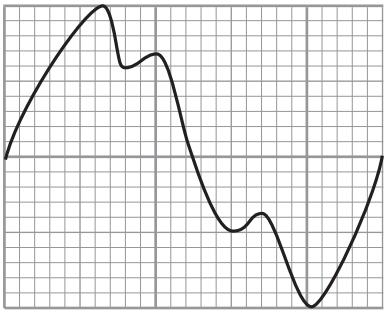
(2 marks)

5

Turn over for the next question

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3 (a) The diagrams show the waveform for a musical note played on two different instruments. The notes have the same pitch.





3 (a) (i) Apart from pitch, in what other way are the two notes the same?

.....

(1 mark)

3 (a) (ii) In what way are the two notes different?

.....

(1 mark)

3 (b) Listening to loud music can damage hearing.

3 (b) (i) What property of a sound wave determines the loudness of the sound?

.....

(1 mark)

3 (b) (ii) The music played at an indoor concert may sound louder than the same music played equally loudly at an outdoor concert.

Suggest why.

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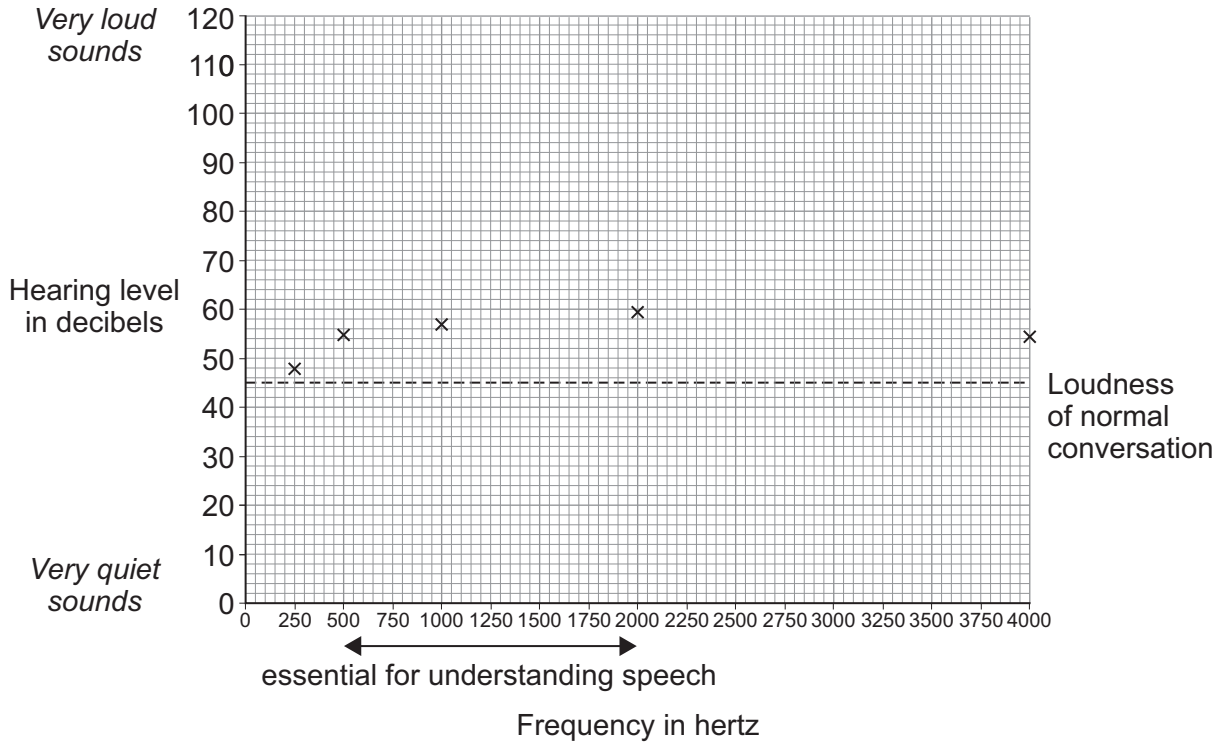
.....

(1 mark)

Do not write outside the box

3 (c) An audiogram displays the quietest sounds that a person can hear at particular frequencies.

The diagram shows an audiogram for a person with damaged hearing. Also shown on the audiogram are the frequencies that are needed for understanding speech.



3 (c) (i) Without a hearing aid, this person can hear people only when they talk loudly.

Explain why.

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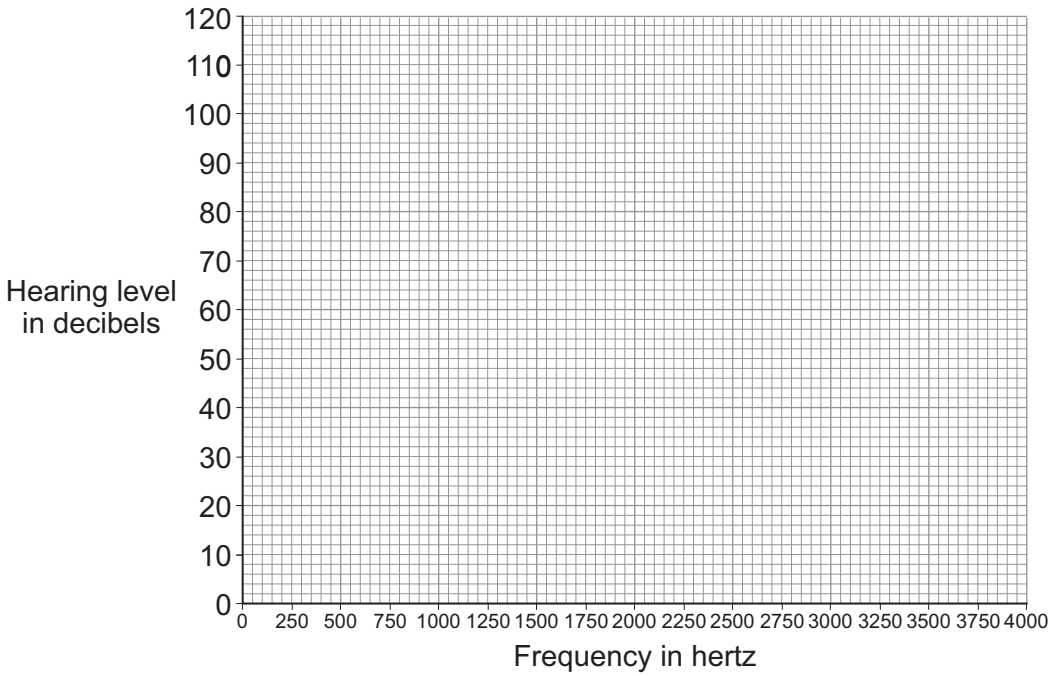
(2 marks)

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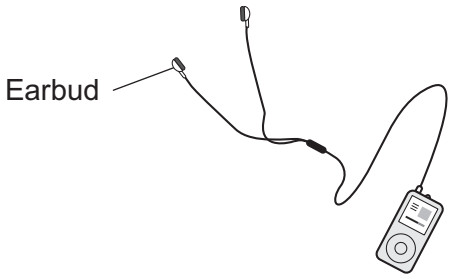
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3 (c) (ii) Someone with normal hearing can hear all frequencies at sound levels below 20 decibels. By drawing crosses (x) on the grid below, complete an audiogram for a person with normal hearing.



(1 mark)

3 (c) (iii) Research has shown that many teenagers are now showing signs of damaged hearing. Although the evidence is not conclusive, there is a strong suggestion that listening to loud music through earbuds is partly to blame.



It is important that teenagers understand the possible risk of listening to loud music through earbuds.

Suggest why.

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(1 mark)

8

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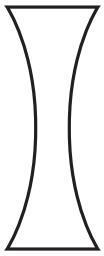
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ANSWER IN THE SPACES PROVIDED

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4 (a) Different shaped lenses are used to correct different types of eye defect.

The diagram shows the type of lens used to correct a defect called short-sight.



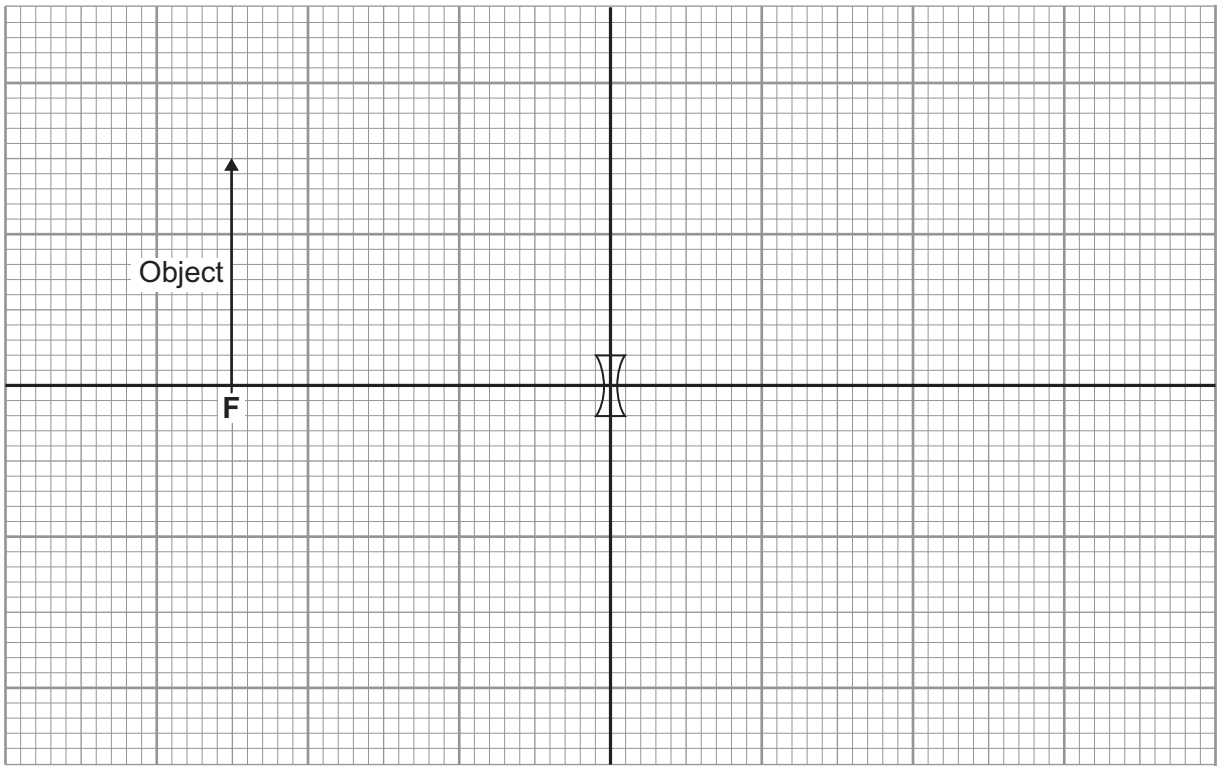
What name is given to a lens with this shape?

.....

(1 mark)

4 (b) The diagram below shows the positions of an object and a lens. The lens is represented by a vertical line. Someone looking through the lens can see an image of the object.

4 (b) (i) On the diagram, use a ruler to draw two rays from the top of the object, to show how and where the image is formed. Use an arrow to represent the image. The arrow should be drawn to the correct size and at the correct position.



(3 marks)

Do not write outside the box

4 (b) (ii) Use the equation in the box to calculate the magnification produced by the lens.

$$\text{magnification} = \frac{\text{image height}}{\text{object height}}$$

Show clearly how you work out your answer.

.....

.....

Magnification = ...

(2 marks)

4 (b) (iii) This type of lens always produces a virtual image.

How can you tell from the completed ray diagram that this image is virtual?

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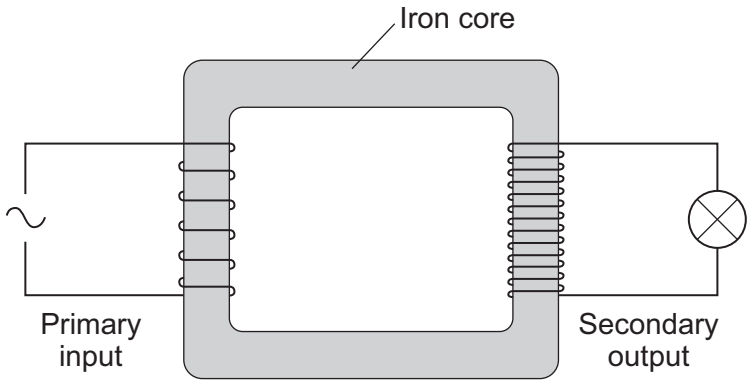
(1 mark)

7

Turn over for the next question

Do not write outside the box

5 The diagram shows a transformer.



5 (a) (i) Is the transformer in the diagram being used as a step-up transformer or as a step-down transformer?

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

a step-up transformer ☐

a step-down transformer ☐

Give a reason for your answer.

.....

.....

(1 mark)

5 (a) (ii) Why is the core made of iron?

.....

.....

(1 mark)

Do not write outside the box

5 (b) The power supply to a laptop computer contains a transformer designed to change the 230 V mains input to a 15 V output. The transformer has 920 turns on its primary coil.

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

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

Show clearly how you work out your answer.

.....

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Number of turns on the secondary coil = ...

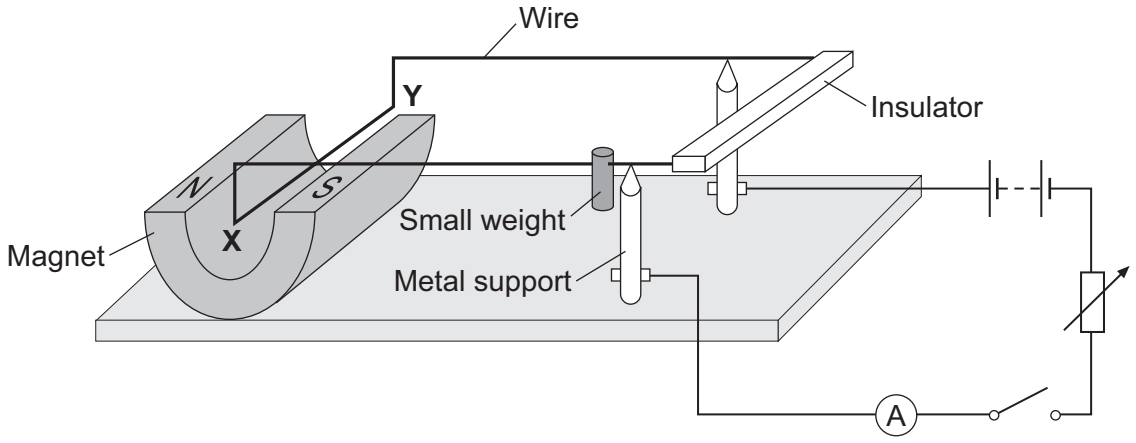
(2 marks)

4

Turn over for the next question

Do not write outside the box

6 (a) The diagram shows a device called a current balance.



6 (a) (i) When the switch is closed, the part of the wire labelled **XY** moves upwards.

Explain why.

.....

.....

.....

.....

(2 marks)

6 (a) (ii) What is the name of the effect that causes the wire **XY** to move?

.....

(1 mark)

6 (a) (iii) An alternating current (a.c.) is a current which reverses direction. How many times the current reverses direction in one second depends on the frequency of the alternating supply.

Describe the effect on the wire **XY** if the battery is replaced by an a.c. supply having a frequency of 5 hertz.

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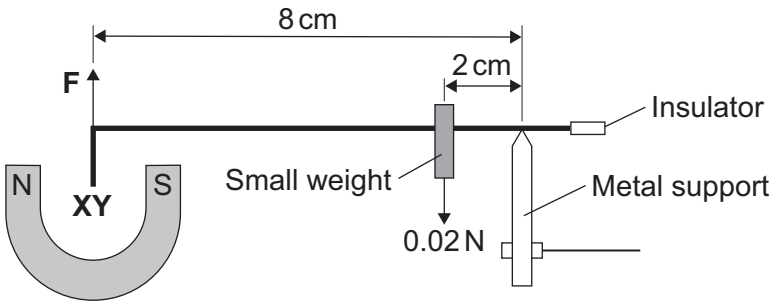
.....

.....

(2 marks)

Do not write outside the box

6 (b) The diagram shows how a small weight can be used to make the wire **XY** balance horizontally.



Side view

Use the data in the diagram and the equation in the box to calculate the force, **F**, acting on the wire **XY**.

moment	=	force	×	perpendicular distance from the line of action of the force to the axis of rotation

Show clearly how you work out your answer.

.....

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.....

Force = ... N

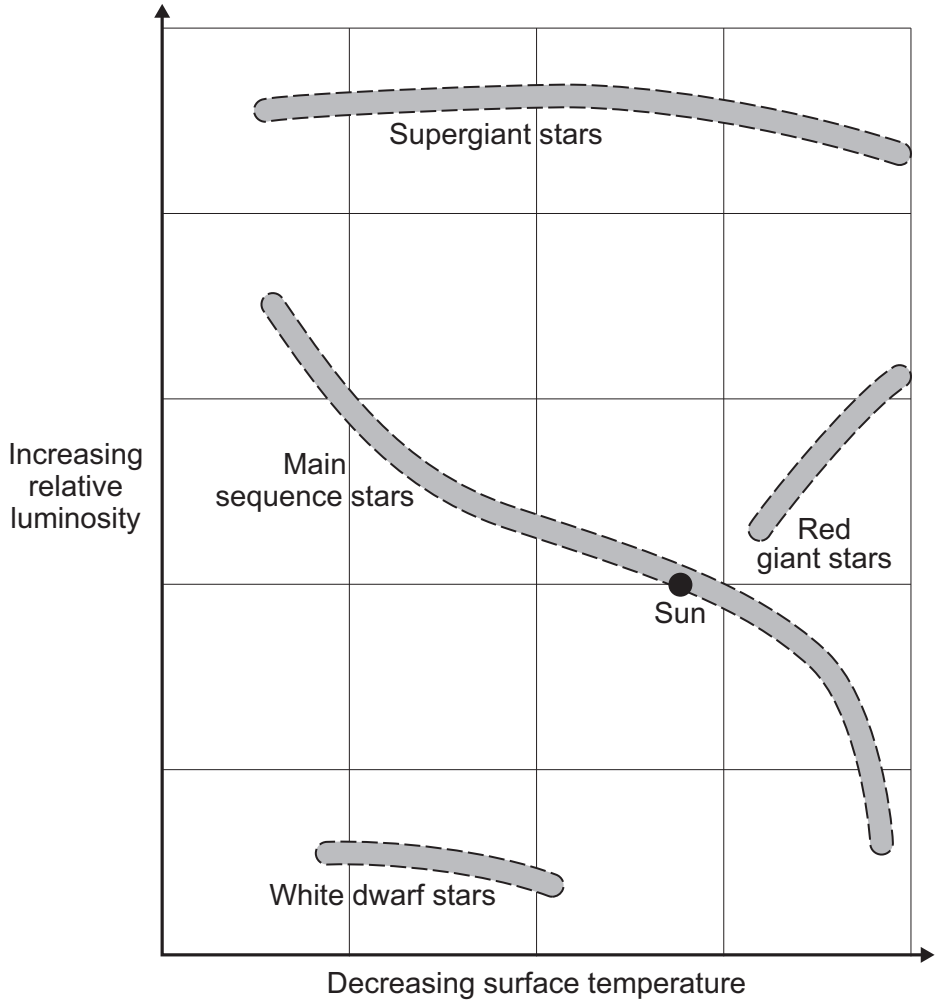
(3 marks)

8

Turn over for the next question

Do not write outside the box

7 The diagram, drawn below, places stars in one of four groups.
Where a star is placed on the diagram is determined by the surface temperature and relative luminosity of the star.
A star with a relative luminosity of 1, emits the same amount of energy every second as the Sun.



7 (a) The Sun will spend most of its life cycle as a main sequence star. This is the stable period of the Sun's life cycle.

What happens to cause the stable period in the life cycle of a star to end?

.....

.....

(1 mark)

Do not write outside the box

7 (b) Use the information in the diagram to describe what will happen to the Sun after the stable period ends.

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(3 marks)

4

END OF QUESTIONS

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General Certificate of Secondary Education

Physics 4451

PHY3H Unit Physics 3

Mark Scheme

2012 examination – June series

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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 meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting 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 the standardisation meeting each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting 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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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 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 lines 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 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 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.

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

Student	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	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, as shown in the column 'answers', 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;

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.

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Quality of Written Communication and levels marking

In Question 8 students 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.

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.

PHY3H

Question 1

question	answers	extra information	mark
1(a)(i)	towards the centre of the circle	accept inwards accept a correct description 'along the string' is insufficient	1
1(a)(ii)	tension (in the string) **or** weight (on the end of the string)	accept pull of the string 'the string' is insufficient 'the student' is insufficient 'turning action' is insufficient	1
1(b)(i)	each may (also) affect the speed so only one independent variable	accept results for speed accept only one variable affects dependent variable 'fair test' is insufficient 'they are control variables' is insufficient	1 1
1(b)(ii)	continuous dependent	both required	1
1(b)(iii)	reduces (absolute) timing error (for one rotation) **or** increases / improves reliability / accuracy (for one rotation)	accept too fast to time one ignore checking for anomalous results to work out an average is insufficient	1
1(c)	speed increases with centripetal force	accept positive correlation do **not** accept proportional	1
1(d)(i)	gravitational pull (of the Earth)	accept gravity	1

Question 1 continues on the next page

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PHY3H

Question 1 continued

question	answers	extra information	mark
1(d)(ii)	**No** geostationary orbits once every 24 hours	both parts required – however this may have been subsumed within the reason accept a correct comparative description	1
Total			**9**

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PHY3H

Question 2

question	answers	extra information	mark
2(a)	method of suspending card through one hole	eg supported pin / nail through hole	1
	use of plumb line suspended from same point as card	term plumb line is not essential	1
	repeating for a second hole		1
		mark points can be scored from labelled diagram(s)	
		unlabelled diagram(s) alone score(s)a maximum of **1** mark	
2(b)	suspended card and plumb line from third hole and mark (new) line	accept repeat experiment using the third hole	1
	if accurate 3 lines cross at same point		1
	or		
	place card on finger (tip) (1)	accept alternatives eg pin	
		accept suspend card from point where lines cross	
	balances where lines cross (1)	accept 'centre of mass' for where lines cross	
		'card balances' is insufficient	
Total			**5**

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PHY3H

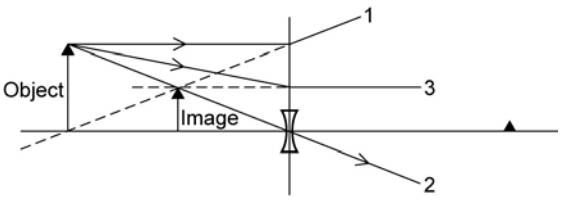
Question 3

question	answers	extra information	mark
3(a)(i)	same frequency / wavelength / amplitude / loudness	accept (time) period do **not** accept volume	1
3(a)(ii)	quality	accept timbre do **not** credit descriptions of wave shapes	1
3(b)(i)	amplitude	accept energy ignore volume	1
3(b)(ii)	sound reflected (from concert hall walls)	accept sound echoes (from concert hall walls) accept closer to speakers	1
3(c)(i)	(minimum) hearing level is above normal conversational level talking loudly increases sound level / loudness above (minimum) hearing level of person	 accept 58-60 dB inclusive for hearing level	1 1
3(c)(ii)	all crosses to be between 0 and 20 inclusive	minimum of two crosses	1
3(c)(iii)	can make an (informed) choice about listening to loud music using earbuds / accepting risk (to hearing) **or** more likely to take steps to reduce risk	 accept a sensible specific suggestion eg reduce volume on mp3 player / change type of earphone	1
Total			**8**

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PHY3H

Question 4

question	answers	extra information	mark
4(a)	diverging	accept concave accept bi-concave accept double concave do **not** accept plano-concave	1
4(b)(i)	any **two** from: 1. ray parallel to principal axis from the top of the object, diverges through lens, traced back through **F** 2. ray passing through centre of lens 3. ray heading to focus on right of lens, diverges through lens parallel to principal axis, traced back parallel to principal axis arrow(s) showing correct direction  	if three rays or more are drawn apply the list rule this mark only scores if all rays drawn are shown refracted only required once but any contradictory arrows negate this mark ignore arrows on construction lines – construction lines may be solid	2 1
4(b)(ii)	0.5 or 1/2 **or** answer obtained from their correctly drawn diagram	to gain both marks there must be a correctly drawn diagram with or without image shown for an incorrect diagram allow **1** mark for the image clearly shown and the size measured accurately ignore any units	2

Question 4 continues on the next

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PHY3H

Question 4 continued

question	answers	extra information	mark
4(b)(iii)	image formed by the intersection of virtual / imaginary ray(s) (and real ray)	accept the image is on the same side (of the lens) as the object accept (real) rays do not cross do **not** accept answers in terms of image in front or behind lens do **not** credit answers in terms of cannot be projected onto screen	1
Total			**7**

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PHY3H

Question 5

question	answers	extra information	mark
5(a)(i)	step-up more turns on the secondary / output (coil)	both parts required do **not** accept coils for turns 'secondary output is greater than primary input' is insufficient	1
5(a)(ii)	(easily) magnetised (and demagnetised)	accept (it's) magnetic it's a conductor negates answer	1
5(b)	60	allow **1** mark for correct substitution ie $\frac{230}{15} = \frac{920}{N_s}$	2
Total			**4**

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PHY3H

Question 6

question	answers	extra information	mark
6(a)(i) E	current produces a magnetic field (around XY) (creating) a force (acting) on XY / wire / upwards	accept current (in XY) is perpendicular to the (permanent) magnetic field reference to Flemings left hand rule insufficient	1 1
6(a)(ii) G	motor (effect)		1
6(a)(iii) E	vibrate / move up and down 5 times a second	 only scores if first mark point scores allow for **1** mark only an answer 'changes direction 5 times a second'	1 1
6(b) E	0.005	 allow **1** mark for calculating moment of the weight as 0.04 (Ncm) and allow **1** mark for correctly stating principle of moments **or** allow **2** marks for correct substitution ie F x 8 = 2 x 0.02 **or** F x 8 = 0.04	3
Total			**8**

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PHY3H

Question 7

question	answers	extra information	mark
7(a) E	runs out of hydrogen (in its core)	accept nuclear fusion slows down do **not** accept fuel for hydrogen do **not** accept nuclear fusion stops ignore reference to radiation pressure / unbalanced forces	1
7(b) E	temperature decreases / (relative) luminosity increases as it changes to a red giant temperature increases / (relative) luminosity decreases as it changes to a white dwarf correct change in temperature **and** (relative) luminosity as Sun changes to a red giant and then to a white dwarf	if both temperature and luminosity are given both must be correct if both temperature and luminosity are given both must be correct an answer changes to a red giant and then white dwarf with no mention or an incorrect mention of temperature or (relative) luminosity change gains **1** mark only if no other marks awarded ignore correct or incorrect stages given beyond white dwarf	1 1 1
Total			**4**

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

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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	
TOTAL	

General Certificate of Secondary Education
Higher Tier
January 2012

Physics

PHY3H

H

Unit Physics P3

Written Paper

Monday 30 January 2012 1.30 pm to 2.15 pm

For this paper you must have:
- a ruler.

You may use a calculator.

Time allowed
- 45 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. 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 45.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

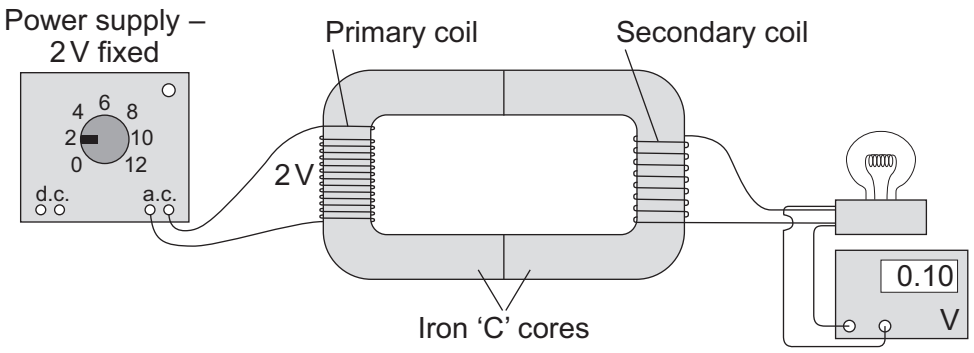
Advice
- In all calculations, show clearly how you work out your answer.

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Do not write outside the box

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

1 The diagram shows the apparatus used by a student to investigate a transformer.



1 (a) The transformer made by the student would not have worked if the core had been made from aluminium and not iron.

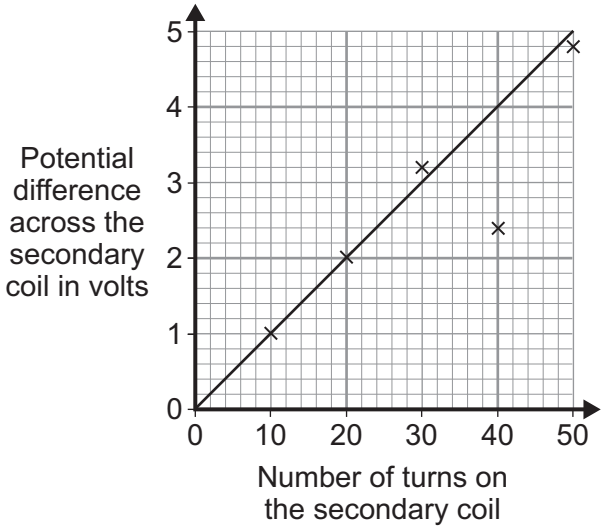
Why?

.....

.....

(1 mark)

1 (b) The student made changes to the number of turns used to make the secondary coil. He then measured the potential difference across the secondary coil after each change. The graph shows the student's results.



Do not write outside the box

1 (b) (i) What range of values was used for the number of turns on the secondary coil?

From ..... to .....

(1 mark)

1 (b) (ii) When he drew the line of best fit, the student ignored one of the data points.

Why?

.....

.....

(1 mark)

1 (b) (iii) What is the minimum number of turns needed on the secondary coil for the transformer to act as a step-up transformer?

.....

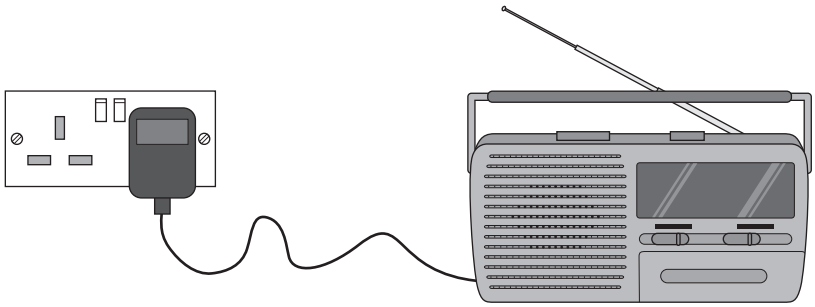
Give a reason for your answer.

.....

.....

(2 marks)

1 (c) A radio can be used with a 9 V battery or it can be plugged into the 230 V mains electricity supply using an adapter. The mains adapter contains a transformer.



Why must the mains adapter contain a transformer?

.....

.....

(1 mark)

6

Turn over ▶

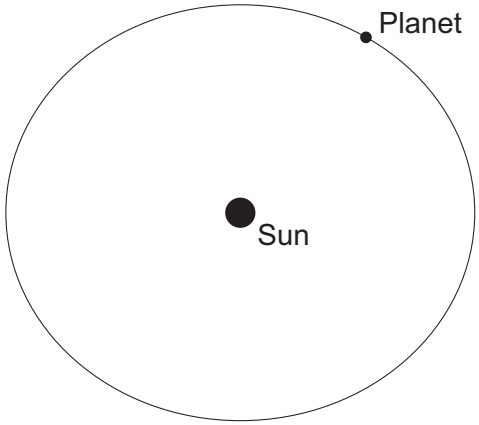
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ANSWER IN THE SPACES PROVIDED

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2 (a) The diagram shows the orbit of a planet in the Solar System. The orbit is shaped like a slightly squashed circle.



Not drawn to scale

2 (a) (i) What word is used to describe the shape of the planet's orbit?

.....

(1 mark)

2 (a) (ii) A planet is kept in its orbit by a centripetal force.

What provides the centripetal force on a planet?

.....

(1 mark)

2 (a) (iii) On the diagram above, draw an arrow to show the direction of the centripetal force acting on the planet.

(1 mark)

2 (a) (iv) Name **two** factors that affect the size of the centripetal force acting on the planet.

1 .....

.....

2 .....

.....

(2 marks)

Question 2 continues on the next page

Do not write outside the box

2 (b) In 1772, the astronomer J. Bode developed a law to calculate the distance a planet is from the Sun. Most scientists at the time did not think that the law was very important.

The table gives the distances calculated using Bode's Law and the actual distances from the Sun for the six planets known to exist in 1772.

Planet	Distance calculated using Bode's Law in AU	Actual distance in AU
Mercury	0.4	0.4
Venus	0.7	0.7
Earth	1.0	1.0
Mars	1.6	1.5
	2.8	
Jupiter	5.2	5.2
Saturn	10.0	9.5

(1 AU = distance between the Earth and the Sun)

2 (b) (i) Considering only these six planets, do you think that Bode's Law gives accurate values for the distances the planets are from the Sun?

Draw a ring around your answer. **Yes** **No**

Give a reason for your answer.

.....

.....

(1 mark)

Do not write outside the box

2 (b) (ii) Bode's Law predicts the existence of a planet between Mars and Jupiter.
In 1801, Ceres, the largest object between Mars and Jupiter, was discovered orbiting the Sun at a distance of 2.8 AU.
Ceres is no longer considered to be a planet.

Explain how the discovery of Ceres in 1801 may have changed scientists' opinions of Bode's Law.

.....

.....

.....

.....

(2 marks)

2 (b) (iii) Since 1801, more planets and other objects have been discovered orbiting the Sun.
These discoveries have led some scientists to develop new versions of Bode's Law.

Suggest why scientists may decide that a new version of Bode's Law is needed.

.....

.....

.....

(1 mark)

9

Turn over for the next question

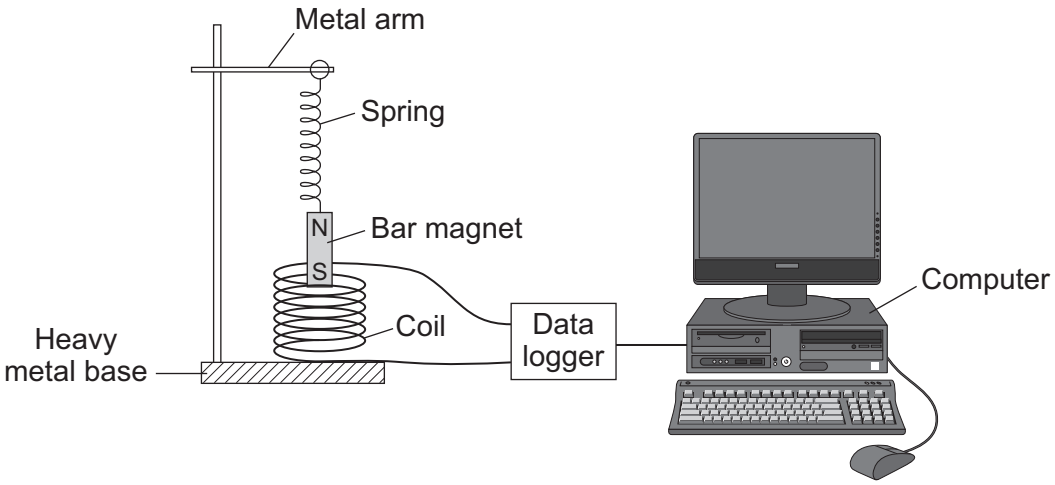
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ANSWER IN THE SPACES PROVIDED

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3 The diagram shows an instrument designed to detect earthquakes. An earthquake causes the ground to vibrate up and down. This causes the bar magnet to move up and down relative to the coil.



3 (a) Explain why the ground vibrations cause an electric current to be induced in the coil. The first sentence of the explanation has been done for you.

The vibrations from the ground cause the bar magnet to move up and down relative to the coil.

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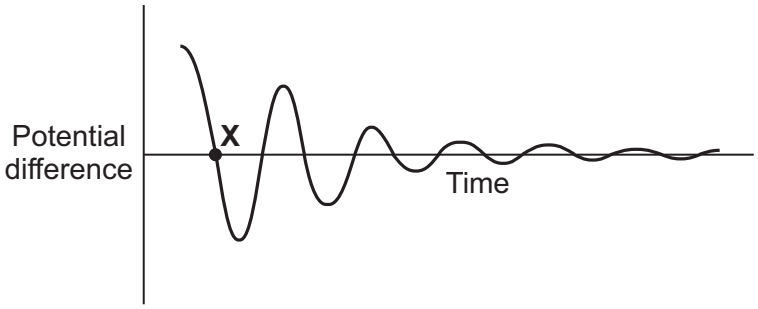
(3 marks)

Question 3 continues on the next page

Turn over ▶

Do not write outside the box

3 (b) The diagram shows the data recorded by the computer following an earthquake.



Which **one** of these statements describes how the magnet is moving relative to the coil when the reading, recorded by the computer at the point marked **X**, is zero?

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

It is moving upwards through the coil. ☐

It is moving downwards through the coil. ☐

It is not moving. ☐

Give the reason for your answer.

.....

.....

.....

.....

(2 marks)

Do not write outside the box

3 (c) The instrument is not sensitive enough to detect the smaller vibrations caused by a heavy lorry driving close by.

3 (c) (i) What is meant by the *sensitivity* of an instrument?

.....

.....

(1 mark)

3 (c) (ii) Suggest **two** changes to the design of the instrument, each of which would make it more sensitive to small vibrations.

1 .....

.....

2 .....

.....

(2 marks)

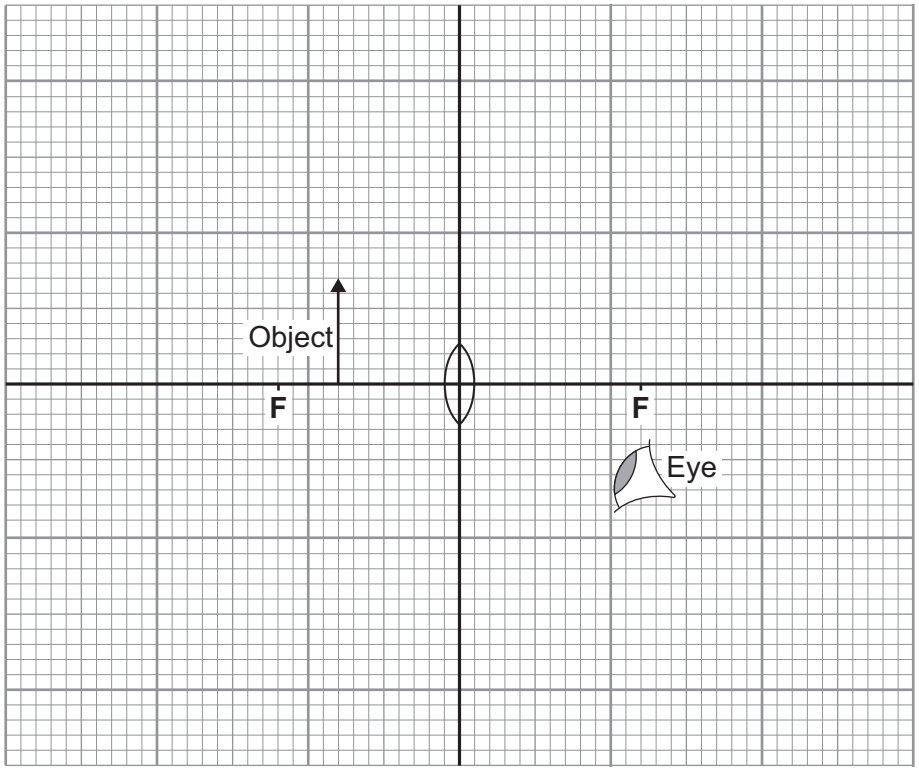
8

Turn over for the next question

Do not write outside the box

4 (a) The diagram shows a converging lens being used as a magnifying glass.

4 (a) (i) On the diagram, use a ruler to draw two rays from the top of the object which show how and where the image is formed. Represent the image by an arrow drawn at the correct position.



(3 marks)

4 (a) (ii) Use the equation in the box to calculate the magnification produced by the lens.

$$\text{magnification} = \frac{\text{image height}}{\text{object height}}$$

Show clearly how you work out your answer.

.....

.....

Magnification = ...

(2 marks)

Do not write outside the box

4 (b) A camera also uses a converging lens to form an image.

Describe how the image formed by the lens in a camera is different from the image formed by a lens used as a magnifying glass.

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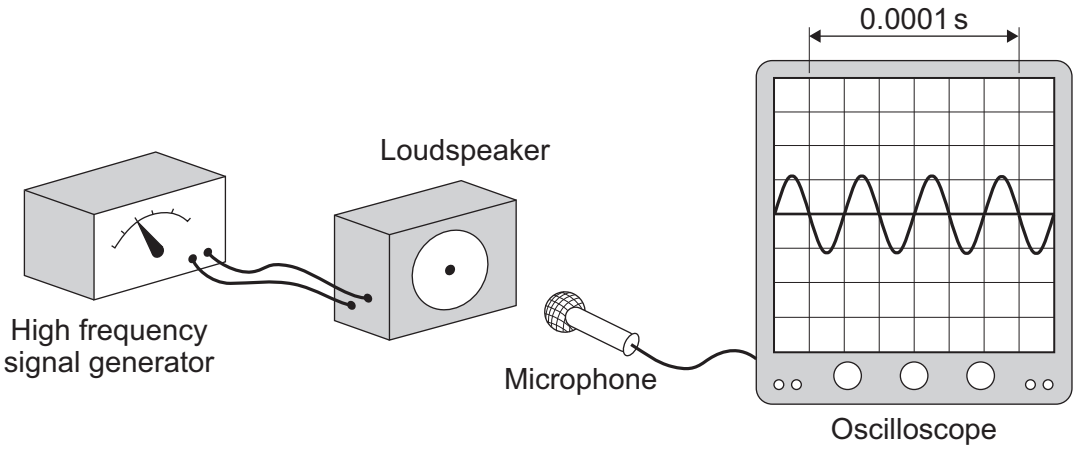
(2 marks)

7

Turn over for the next question

Do not write outside the box

5 (a) The diagram shows a microphone being used to detect the output from a loudspeaker. The oscilloscope trace shows the wave pattern produced by the loudspeaker.



5 (a) (i) How many waves are produced by the loudspeaker in 0.0001 seconds?

.....

(1 mark)

5 (a) (ii) How many waves are produced by the loudspeaker every second?
Assume the input to the loudspeaker does not change.

.....

.....

(1 mark)

5 (a) (iii) A person with normal hearing cannot hear the sound produced by the loudspeaker.

Explain why.

.....

.....

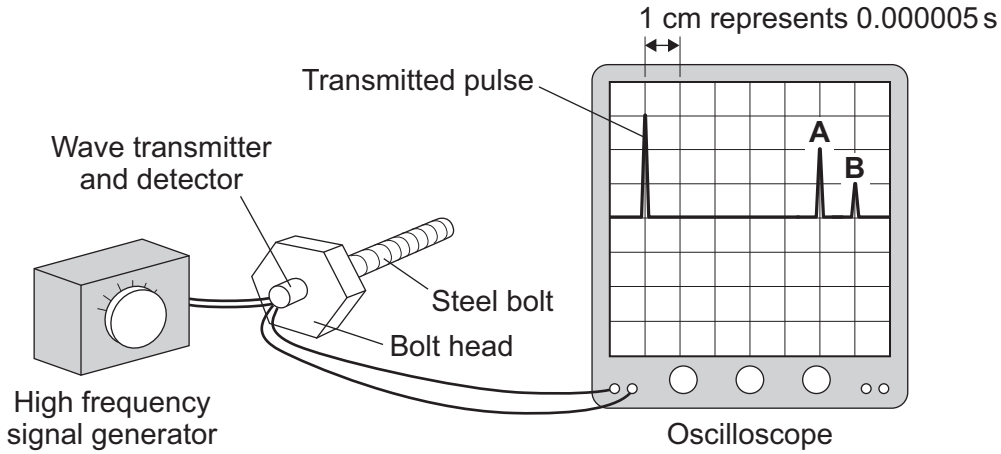
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(2 marks)

Do not write outside the box

5 (b) The diagram shows how a very high frequency sound wave can be used to check for internal cracks in a large steel bolt. The oscilloscope trace shows that the bolt does have an internal crack.



5 (b) (i) Explain what happens to produce pulse **A** and pulse **B**.

.....

.....

.....

.....

(2 marks)

5 (b) (ii) Use the information in the diagram and the equation in the box to calculate the distance from the head of the bolt to the internal crack.

distance = speed × time

Speed of sound through steel = 6000 m/s

Show clearly how you work out your answer.

.....

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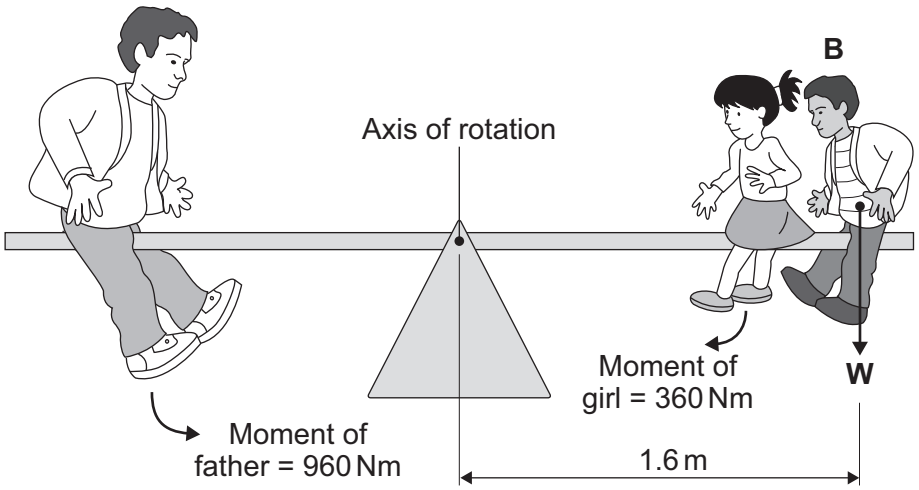
(3 marks)

9

Turn over ▶

Do not write outside the box

6 The diagram shows a father and his two children sitting on a playground see-saw. The see-saw is not moving.



6 (a) What is the total clockwise moment of the two children about the axis of rotation?

.....

Explain the reason for your answer.

.....

.....

.....

.....

.....

.....

(3 marks)

6 (b) (i) What is the clockwise moment of the boy, **B**, about the axis of rotation?

.....

Moment = ... Nm

(1 mark)

Do not write outside the box

6 (b) (ii) Use the information in the diagram and the equation in the box to calculate the weight, **W**, of the boy, **B**.

moment = force × perpendicular distance from the line of action of the force to the axis of rotation

Show clearly how you work out your answer.

.....

.....

.....

.....

Weight of boy **B** = ... N

(2 marks)

6

END OF QUESTIONS

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Version1.0: 29/03/2012

General Certificate of Secondary Education

Physics 4451

PHY3H Unit Physics 3

Mark Scheme

2012 Examination – January Series

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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 meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting 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 the standardisation meeting each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting 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.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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Marking Guidance for Examiners

GCSE Science Papers

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 lines 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 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 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.

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

Student	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

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

Student	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, 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, as shown in the column 'answers', 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;

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.

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Question 1

question	answers	extra information	mark
1(a)	aluminium cannot be magnetised	accept aluminium is not magnetic "it" refers to aluminium do **not** accept aluminium is not easily magnetised reference to conduction and aluminium negates mark iron can be magnetised is insufficient	1
1(b)(i)	10 to 50	either order	1
1(b)(ii)	(data is) anomalous	accept does **not** fit the pattern it is an error is insufficient	1
1(b)(iii)	21 secondary p.d. (just) larger than primary p.d. **or** there must be more turns on the secondary coil than primary coil	accept 22 do **not** accept any fraction of a turn ie 20.1 accept output (just) larger than input/2V do **not** accept coil for turns	1 1
1(c)	to reduce/step-down the (input) p.d./voltage	mains p.d. is too high is insufficient step-down transformer is insufficient answers in terms of changing/ stepping-up current **or** fuse blowing **or** not working with 230 volts are insufficient any mention of step-up negates mark stepping down both voltage/p.d. **and** current negates mark	1
Total			**6**

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Question 2

question	answers	extra information	mark
2(a)(i)	ellipse/elliptical	accept oval/ovoid egg shape is insufficient	1
2(a)(ii)	gravitational attraction (between the Sun and the planet)	allow (force of) gravity allow force due to mass of the planet **and** mass of the Sun the Sun is insufficient do **not** accept references to weight	1
2(a)(iii)	arrow drawn from planet pointing towards the Sun		1
2(a)(iv)	any **two** from: • mass of the planet • distance between the planet and Sun • mass of the Sun • speed of planet	 size of the planet insufficient do **not** accept references to weight accept radius of orbit size of Sun insufficient	2
2(b)(i)	YES equal/close to the actual/true distances	no mark for this, mark is for reason does not score if NO is chosen accept (calculated) data is (generally) accurate	1

Question 2 continues on the next page . . .

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Question 2 continued . . .

question	answers	extra information	mark
2(b)(ii)	Ceres/discovery agrees/supports prediction **or** Ceres in predicted position accept Bode's Law **or** (now) think it's important	"it" refers to Ceres/discovery	1 1
2(b)(iii)	idea of new evidence not supporting/being in agreement with existing law	accept the idea of needing to modify the law to take account of the new data do **not** accept the universe is expanding so (Bode's) data is invalid answers in terms of new technology are insufficient answers in terms of making the law better/more reliable are insufficient	1
Total			**9**

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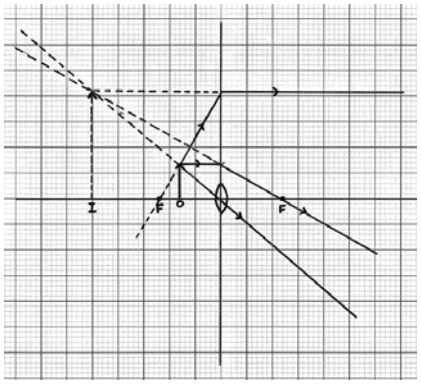
Question 3

question	answers	extra information	mark
3(a)		accept throughout wire/turns for coil provided the meaning is clear	
	magnetic field (lines) cut by coil	magnet cuts the coil is insufficient current induced in coil is insufficient	1
	p.d. induced across (ends of)/in coil		1
	coil is part of a complete circuit		1
3(b)	it is not moving		1
	p.d. is zero **or** magnetic field lines not being cut (by coil)	reason only scores if first marking point awarded	1
3(c)(i)	smallest change (in value) instrument can measure	accept smallest vibration that can be detected do **not** accept it is the smallest value that can be measured	1
3(c)(ii)	any **two** from:		2
	• stronger/more powerful magnet	accept (use a) heavier magnet bigger magnet is insufficient	
	• more turns (on the coil) **or** turns (of coil) pushed closer together	bigger coil is insufficient do **not** accept more coils of wire	
	• less stiff spring	accept weaker spring do **not** accept smaller/looser spring	
Total			**8**

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Question 4

question	answers	extra information	mark
4(a)(i)	**two** correct rays drawn • ray parallel to axis from top of object **and** refracted through focus **and** traced back beyond object • ray through centre of lens **and** traced back beyond object • ray joining top of object to focus on left of lens taken to the lens refracted parallel to axis **and** traced back parallel to axis beyond object an arrow showing the position **and** correct orientation of the image for their rays	**1** mark for each correct ray  to gain this mark, the arrow must go from the intersection of the traced-back rays to the axis **and** the image must be on the same side of the lens as the object and above the axis	2 1
4(a)(ii)	(x) 3.0 **or** $\frac{\text{their image height}}{\text{object height}}$ correctly calculated	accept 3.0 to 3.5 inclusive allow **1** mark for correct substitution into equation using their figures ignore any units	2
4(b)	any **two** from: in a camera the image is: • real not virtual • inverted and not upright • diminished and not magnified	both parts of each marking point are required accept upside down for inverted accept smaller and bigger accept converse answers but it must be clear the direction of the comparison	2
Total			**7**

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Question 5

question	answers	extra information	mark
5(a)(i)	3		1
5(a)(ii)	30 000 **or** 10 000 × their (a)(i) correctly calculated		1
5(a)(iii)	any **two** from: • frequency is above 20 000 (Hz) • frequency is above the upper limit of audible range • upper limit of audible range equals 20 000 (Hz) • it is ultrasound/ultrasonic	 accept the frequency is 30 000 ignore reference to lower limit 	2
5(b)(i)	wave (partially) reflected at crack to produce **A** and end of bolt to produce **B**	 accept at both ends of the crack	1 1
5(b)(ii)	0.075 (m)	allow **2** marks for time = 0.0000125 allow **1** mark for time = 0.000025 answers 0.15 **or** 0.015 **or** 0.09 gain **2** marks answers 0.18 **or** 0.03 gain **1** mark the unit is not required but if given must be consistent with numerical answer for the available marks	3
Total			**9**

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Question 6

question	answers	extra information	mark
6(a)	960 (Nm)		1
	see-saw is in equilibrium	accept see-saw is balanced see-saw is stationary is insufficient	1
	(total) clockwise moments = anticlockwise moment	accept no resultant moment forces are balanced is insufficient an answer clockwise moments balance the anticlockwise moments gains **2** marks	1
6(b)(i)	600 (Nm)		1
6(b)(ii)	375 (N) **or** their (b)(i) ÷ 1.6 correctly calculated	do **not** credit if (b)(i) is larger than 960 allow **1** mark for correct substitution **and** transformation ie $\frac{600}{1.6}$ **or** $\frac{\text{their (b)(i)}}{1.6}$	2
Total			**6**

UMS Conversion Calculator
http://web.aqa.org.uk/UMS/index.php

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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 2011

Physics

PHY3H

H

Unit Physics P3

Written Paper

Friday 27 May 2011 9.00 am to 9.45 am

For this paper you must have:
- a ruler.

You may use a calculator.

Time allowed
- 45 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. 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 45.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

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

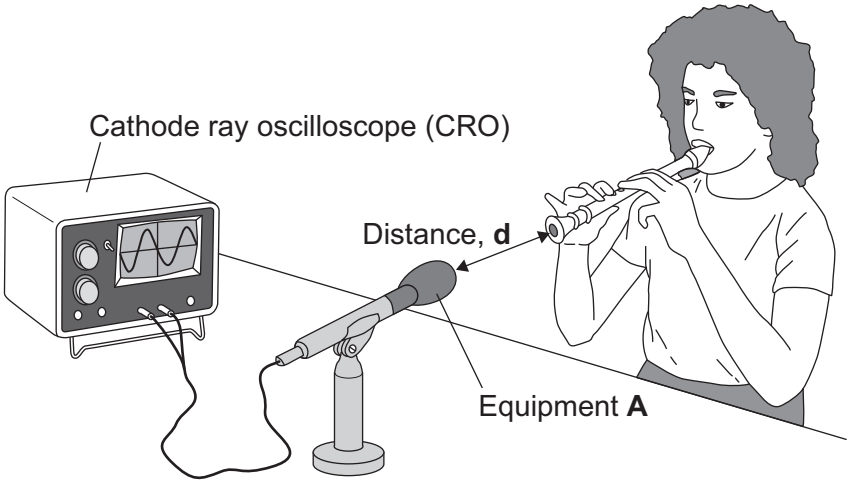
STEMUP.CO.UK

Do not write outside the box

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

1 A group of students investigates sound waves.

The diagram shows part of their investigation.



1 (a) Identify the equipment labelled **A**.

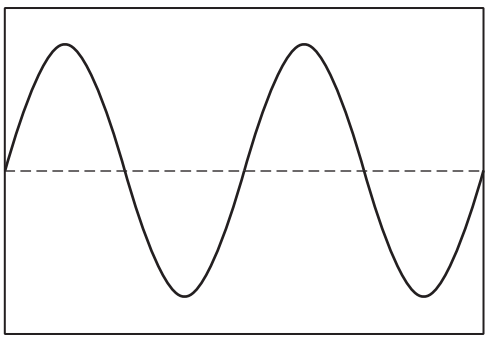
.....

(1 mark)

1 (b) The student plays the same note in the same way at different distances from equipment **A**.

Another student records the amplitude of the wave shown on the cathode ray oscilloscope (CRO).

1 (b) (i) Label this wave to show its amplitude.



(1 mark)

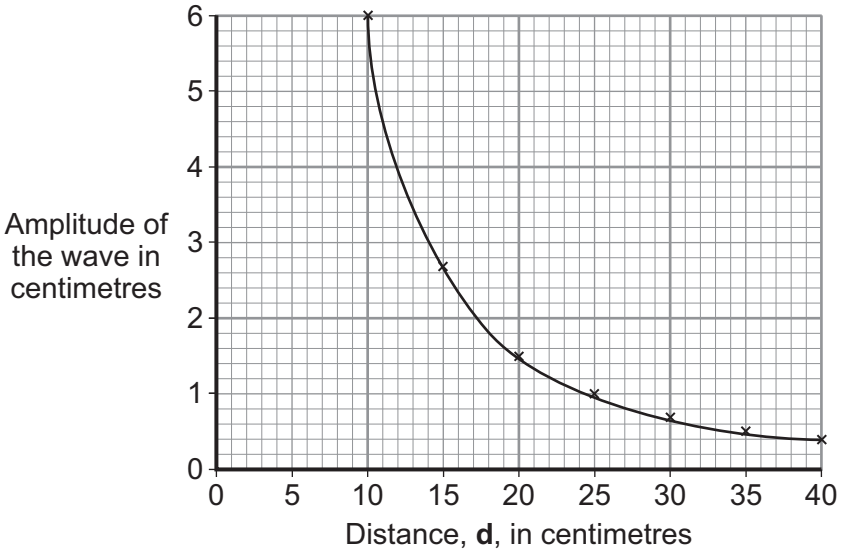
1 (b) (ii) Complete the sentence.

Increasing the amplitude of a sound wave will increase the .....

of the sound. *(1 mark)*

Do not write outside the box

1 (c) The graph shows the students' average results from several sets of measurements.



Use the graph to find the distance, **d**, in centimetres, at which the average amplitude is likely to be 2 centimetres.

Distance = ... cm.

(1 mark)

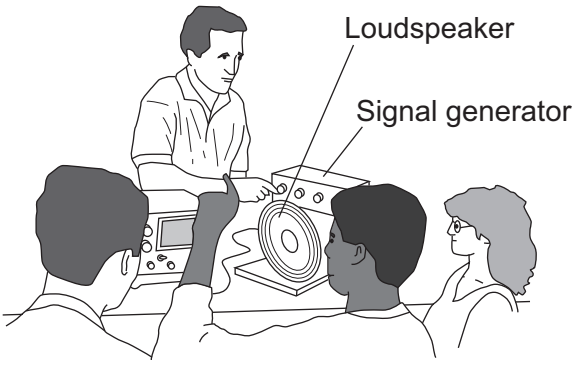
1 (d) Write a conclusion for this investigation.

.....

.....

(1 mark)

1 (e) A physics teacher uses a signal generator and a loudspeaker to demonstrate the range of hearing of a group of students.



What is the range of frequencies most humans can hear?

Most humans can hear from ..... Hz to ..... Hz.

(2 marks)

7

Turn over ▶

Do not write outside the box

2 (a) A student investigates the moment of a force.

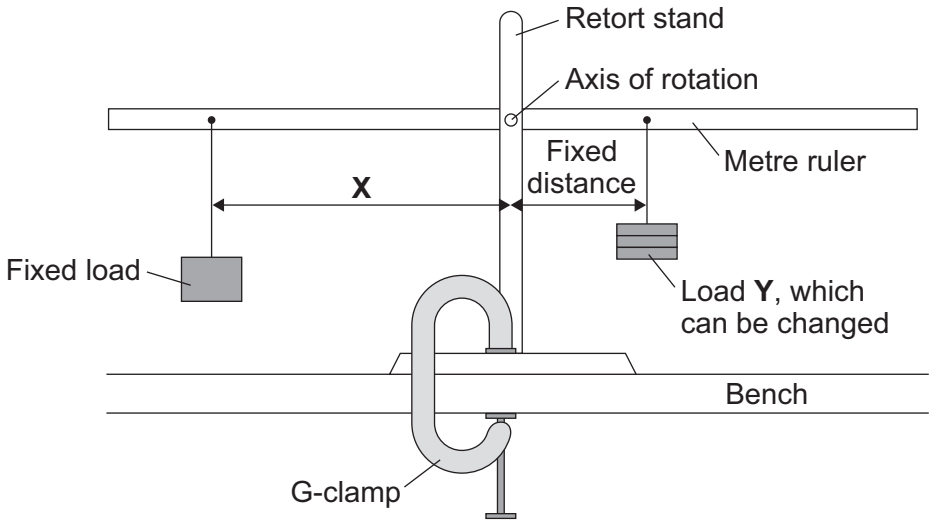
2 (a) (i) What does the word *moment* mean in this sentence?

.....

.....

(1 mark)

2 (a) (ii) The diagram shows how she sets up her apparatus.



Suggest the purpose of the G-clamp.

.....

.....

(1 mark)

Do not write outside the box

2 (a) (iii) A horizontal rod fits into a hole at the centre of the metre ruler. This is the axis of rotation. The student changes the load **Y** and adjusts the distance **X** until the metre ruler is horizontal. She takes six pairs of measurements which are shown in the table.

Load Y in newtons	Distance X in centimetres
1	7
2	14
3	21
4	28
5	35
6	42

Explain fully how distance **X** varies with load **Y**.

.....

.....

.....

.....

.....

(2 marks)

2 (a) (iv) The weight of the ruler can be ignored in this experiment.

Which statement gives the reason why?

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

The weight of the ruler is so small it is negligible. ☐

The centre of mass of the ruler is at the axis of rotation. ☐

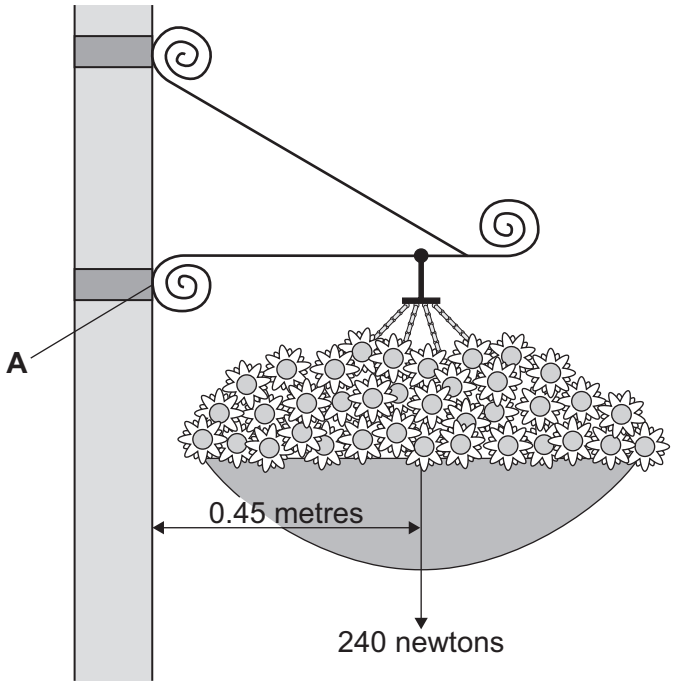
The ruler is a symmetrical object. ☐

(1 mark)

Question 2 continues on the next page

Do not write outside the box

2 (b) In the summer, a town council fits hanging baskets to some of its lamp posts.



Use the information in the diagram and the equation in the box to calculate the moment produced by the weight of the hanging basket about an axis through point **A**.

moment = force × perpendicular distance from the line of action of the force to the axis of rotation

Show clearly how you work out your answer **and** give the unit.

.....

.....

.....

.....

Moment =.....

(3 marks)

8

Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

3 Jupiter is the largest planet in the solar system. It has over sixty moons. The four largest moons were observed by Galileo using his telescope over four hundred years ago.

The table displays some of the data on these four largest moons which is now known to scientists.

Name	Distance from Jupiter in kilometres	Time to orbit Jupiter in days	Diameter in kilometres	Mass in quintillion tonnes
Callisto	1 883 000	16.9	4806	108
Europa	671 000	3.6	3130	48
Ganymede	1 070 000	7.2	5268	148
Io	422 000	1.8	3630	89

1 quintillion tonne = 1 000 000 000 000 000 000 tonnes

3 (a) A centripetal force acts on each of these moons.

State clearly what provides the centripetal force.

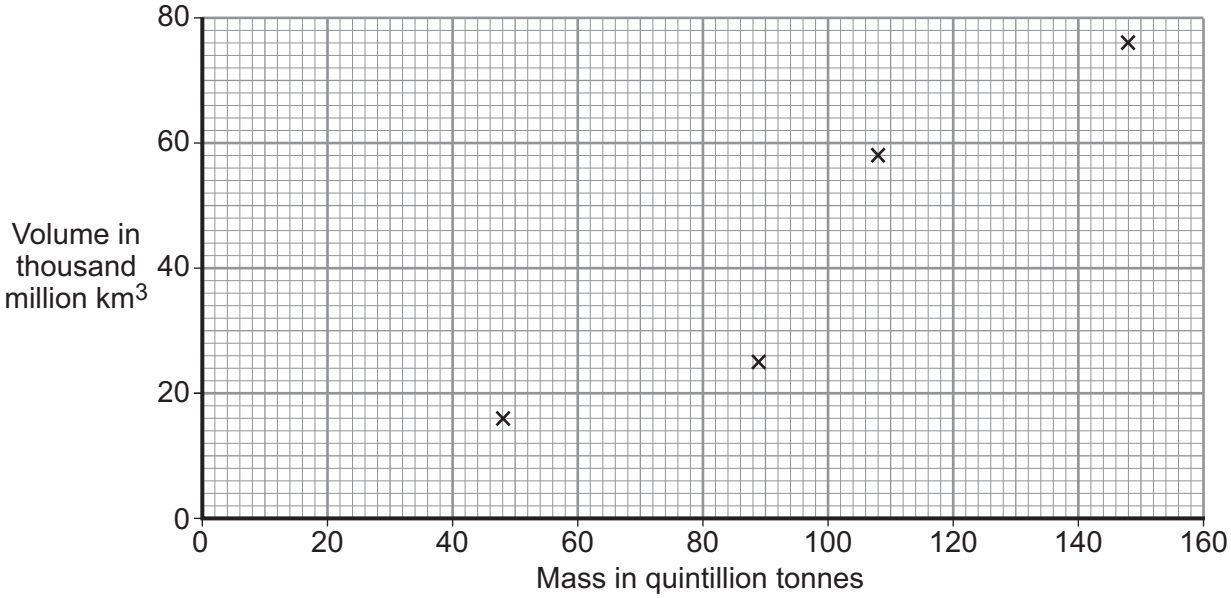
.....

.....

(1 mark)

Do not write outside the box

3 (b) The graph shows the volume against mass for these large moons.



Use the graph to estimate the volume of a moon with a mass of 20 quintillion tonnes.

Show clearly on the graph how you used it to get to your estimate.

Estimated volume of moon = ... thousand million km^3

(2 marks)

3 (c) For these large moons, what is the relationship, if any, between the moon's *distance* from Jupiter and the *time* it takes for the moon to orbit Jupiter?

.....

.....

(1 mark)

3 (d) One reason why astronomers now have more data on the moons of Jupiter is that present-day astronomers have telescopes which are much more powerful than Galileo's telescope.

Give **one** other reason.

.....

.....

(1 mark)

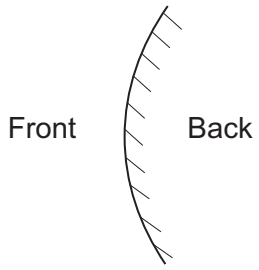
5

Turn over ▶

Do not write outside the box

4 (a) Mirrors with a certain shape can be used in shops and near the stairs in buses.

The diagram below shows a mirror with this shape.



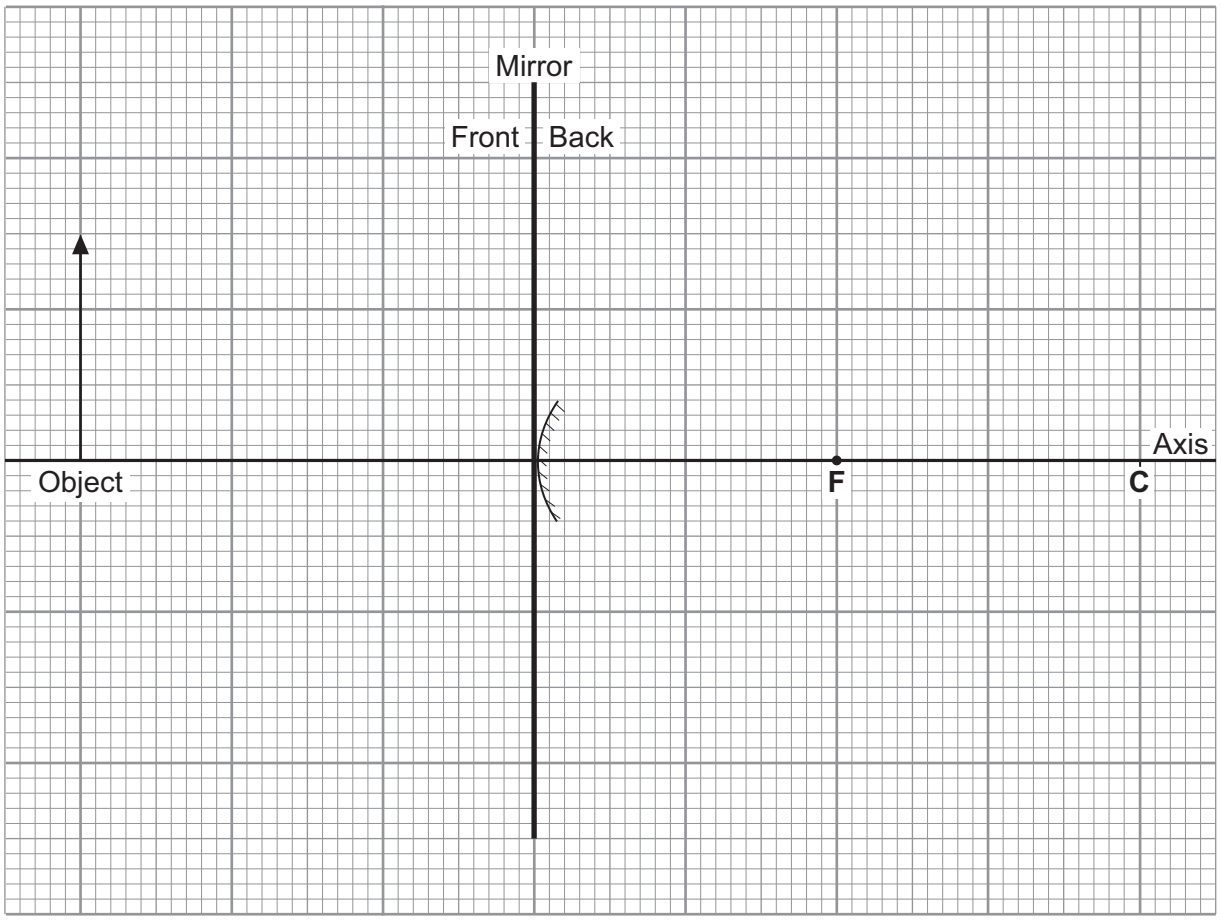
What name is given to this shape of mirror?

.....

(1 mark)

4 (b) The diagram below shows an object in front of a mirror similar to the one in part **4(a)**. The mirror is represented by a vertical line.

On the diagram below, use a ruler to draw two rays from the top of the object which show how and where the image is formed.



(4 marks)

Do not write outside the box

4 (c) All the images formed in this type of mirror are upright.

Describe **two** other properties of these images.

1 .....

2 .....

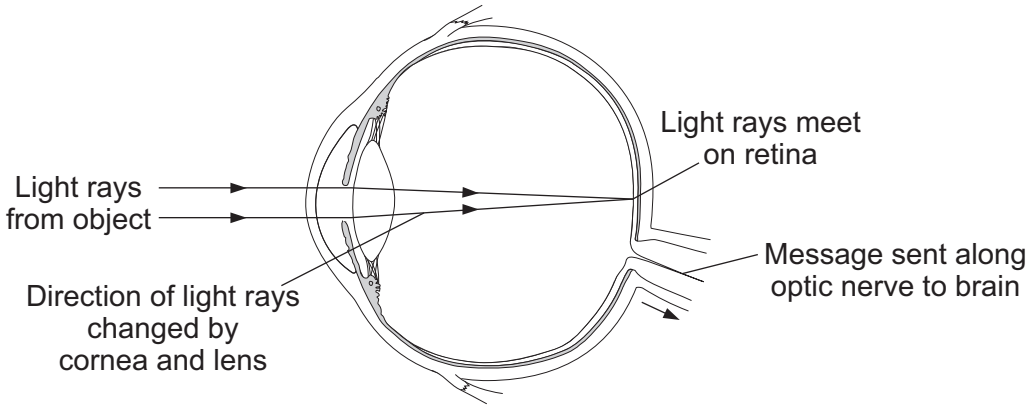
(2 marks)

7

Turn over for the next question

Do not write outside the box

5 (a) The diagram shows the inside of the eye of a person with perfect vision.



Complete the sentence.

The process by which the cornea and lens change the direction of the light is called

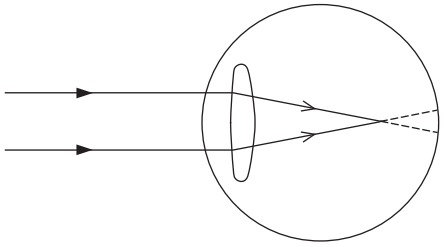
..... .

(1 mark)

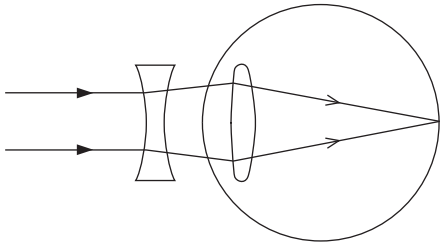
Do not write outside the box

5 (b) (i) Not everyone has perfect vision.
A **short-sighted** person can only clearly see objects which are close.
Light from distant objects meets in front of the retina.

The diagrams show how an additional lens will correct **short-sightedness**.

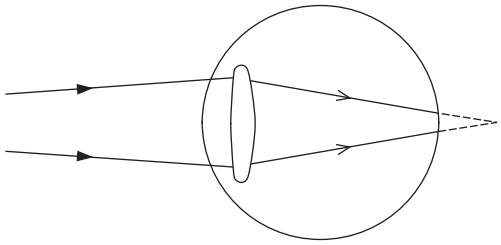


Uncorrected vision



Vision corrected with a diverging lens

The following diagram shows what happens when light from a close object enters the eye of a **long-sighted** person.



Light fails to come to focus on the retina

What type of additional lens will correct the vision of a **long-sighted** person?

.....

(1 mark)

5 (b) (ii) The additional lens changes the direction of the light before it enters the eye.

Why does this correct the person's vision?

.....

.....

(1 mark)

Question 5 continues on the next page

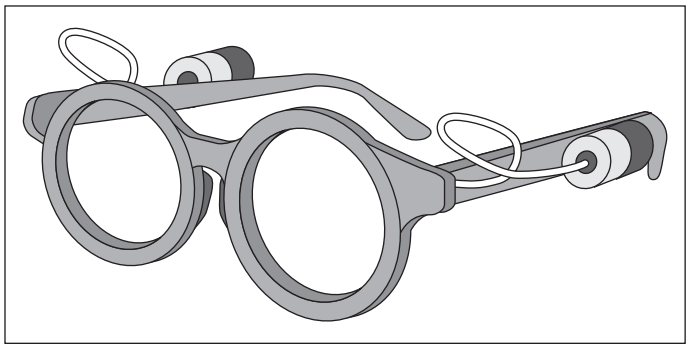
Turn over ▶

Do not write outside the box

5 (c) Read this passage from a magazine.

Professor's clear vision for the future

There are billions of poor people in the world who cannot see clearly and cannot afford the cost of having their eyesight corrected. A professor has invented adjustable glasses. They are cheap and a few minutes is all it takes for you to adjust them to suit your eyes.



When the adjusting screw is turned in one direction, silicone is pushed into the flexible lens which becomes thicker in the centre. Turning the screw in the opposite direction pulls silicone out, and the lens becomes thinner at the centre than at the edge.

Explain how these glasses are adjusted for a **short-sighted** person and how this adjustment allows the person to see distant objects clearly.

.....

.....

.....

.....

.....

(3 marks)

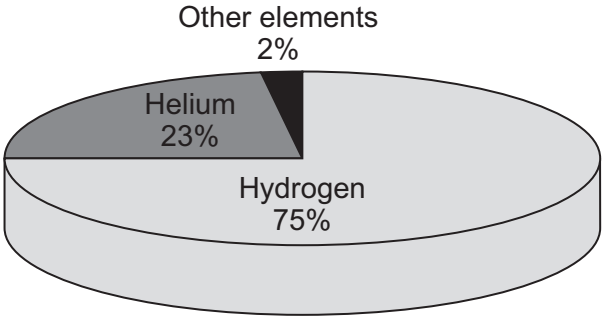
6

Do not write outside the box

6 This passage is from a web page.

Our nearest star, the Sun

The pie chart shows the proportions of chemical elements in the Sun.



Most of the Sun's helium has been produced from the Sun's hydrogen by the process of nuclear fusion. This process also produces vast quantities of energy. The process takes place in the core of the Sun at a temperature of about 15 million °C and has been going on for about 4.5 billion years. During this period of time, the Sun has remained stable and scientists think that it will remain stable for several billion years into the future.

6 (a) Explain why the Sun remains stable.

.....

.....

.....

.....

(3 marks)

6 (b) A scientific opinion is expressed on this web page.

Identify this opinion and suggest how scientists could justify it.

.....

.....

.....

.....

(2 marks)

5

Turn over for the next question

Do not write outside the box

7 (a) In the National Grid, very large step-up transformers link power stations to the transmission cables.

A transformer used for this purpose has 800 turns on its primary coil and 12 800 turns on its secondary coil. The p.d. (potential difference) across its primary coil is 25 kV.

Use the equation in the box to calculate the p.d. across its secondary coil.

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

Show clearly how you work out your answer **and** give the unit.

.....

.....

p.d. across secondary coil = ...

(3 marks)

7 (b) The primary and secondary coils of a transformer are made of insulated wire.

Why is this insulation necessary?

.....

.....

(1 mark)

7 (c) Describe what happens when an alternating potential difference is applied across the primary coil of a transformer.

.....

.....

.....

.....

.....

.....

(3 marks)

7

END OF QUESTIONS

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Version1.0: 29/07/2011

General Certificate of Secondary Education

Physics 4451

PHY3H Unit Physics 3

Mark Scheme

2011 Examination – June Series

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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 meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting 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 candidates' 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 to download from the AQA Website: www.aqa.org.uk

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Marking Guidance for Examiners

GCSE Science Papers

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 lines 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.

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

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

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

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, 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, as shown in the column 'answers', 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;

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.

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PHY3H

Question 1

question	answers	extra information	mark
1(a)	microphone		1
1(b)(i)	vertical line from any maxima or minima to axis	do **not** penalise minor errors but do **not** allow unless intention is clear	1
1(b)(ii)	loudness / volume / intensity / energy	do **not** accept noise	1
1(c)	17	this answer only	1
1(d)	the greater the distance, the smaller the amplitude **or** there is a (strong) negative correlation between distance and amplitude **or** there is an inverse square relationship between distance and amplitude	accept volume / intensity / energy / loudness for amplitude do **not** accept distance and amplitude are inversely proportional	1
1(e)	20 Hz 20,000 Hz	either order accept 20 kHz provided unit has been clearly changed	1 1
Total			**7**

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PHY3H

Question 2

question	answers	extra information	mark
2(a)(i)	turning effect	accept turning force accept force x distance (accept symbols only if correctly defined) do **not** accept newtons x metres	1
2(a)(ii)	stop apparatus falling over	accept holds the stand in place accept make it safer / stable references to balanced / equilibrium are insufficient	1
2(a)(iii)	as x increases y increases in same proportion / ratios	 allow both marks for they are directly proportional **or** a specific example eg doubling y, doubles x allow both marks for a correct answer giving figures eg they increase in the ratio of 1 to 7 allow for **1** mark positive correlation	1 1
2(a)(iv)	the centre of mass of the ruler is at the axis of rotation		1
2(b)	108 newton metres / Nm	allow **1** mark for correct substitution ie 240 x 0.45 symbols must be correct for full credit the unit must be consistent with the numerical answer	2 1
Total			**8**

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PHY3H

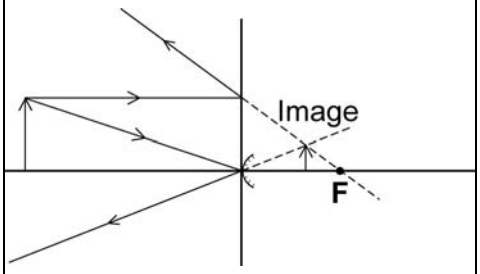
Question 3

question	answers	extra information	mark
3(a)	(Jupiter's) gravitational pull	accept (Jupiter's) gravity	1
3(b)	extrapolation which takes account of the line of best fit passing through the origin (+ / - 1 square) a correct reading taken from the candidate's line (+ / - ½ square)	accept a straight line or curve do **not** accept a line dot to dot if no line drawn allow for **1** mark a value between 8 – 12 inclusive	1 1
3(c)	as the distance increases the time increases **or** as the distance decreases the time decreases **or** there is a positive correlation		1
3(d)	any **one** from: • computers able to process data • telescopes in space / on satellites / above the Earth / atmosphere • instruments other than optical telescopes (available)	 accept better / advanced technology reference to satellites alone insufficient accept any valid reason do **not** accept just better telescopes	1
Total			**5**

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PHY3H

Question 4

question	answers	extra information	mark
4(a)	convex	do **not** accept convex lens do **not** accept diverging	1
4(b)	two rays correctly drawn from the top of the object to the mirror with correct reflection image where virtual rays intersect behind the mirror then vertically downwards to the axis correct ray direction shown by arrow head	allow **1** mark for each only required once but any contrary or ambiguous direction cancels this mark last two marking points only score if rays are shown to be reflected example of a **4** mark response  the other acceptable rays are: from the top of the object directed towards C reflected back along its own path from the top of the object directed towards F reflected at the mirror parallel to the principal axis	2 1 1

Question 4 continues on the next page

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PHY3H

Question 4 continued

question	answers	extra information	mark
4(c)	diminished virtual	accept smaller accept cannot be formed on a screen ignore imaginary either order but do **not** credit either response if directly contradicted eg diminished and enlarged virtual and real	1 1
Total			**7**

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PHY3H

Question 5

question	answers	extra information	mark
5(a)	refraction		1
5(b)(i)	converging	accept convex	1
5(b)(ii)	cause the light (rays) to meet on / focus at retina / back of eye	do **not** accept hit the retina only	1
5(c)	silicone is removed from the lens(es) lens(es) thinner in / at the middle (than at the edge) **or** lens(es) became concave / diverging diverges(s) the light which (now) meets / focuses at the retina / back of the eye		1 1 1
Total			**6**

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PHY3H

Question 6

question	answers	extra information	mark
6(a)	(forces due to) gravity and radiation pressure		1
	correct direction of forces		1
	(forces) are balanced / equilibrium / equal		1
		accept for **3** marks an answer in terms of	
		sufficient hydrogen (1)	
		to keep fusion reaction (1)	
		reference to burn / burning negates this mark	
		going at a continuous /steady rate (1)	
		if fuel is used instead of hydrogen maximum of **2** marks	
6(b)	the Sun will remain stable (for several billion years)		1
	based on evidence	accept a specific example of evidence eg that the Sun has remained stable during the life of our planet / for 4.5 billion years **or** still contains more than 50 % hydrogen **or** by comparison with the lifecycle of (similar) stars	1
		allow a refutation eg not based on prejudice / whim / hearsay / folk law / historical or religious authority	
Total			**5**

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PHY3H

Question 7

question	answers	extra information	mark
7(a)	400 000	allow **1** mark for correct substitution ie $\frac{25000}{?} = \frac{800}{12800}$ **or** $\frac{25}{?} = \frac{800}{12800}$	2
	volt(s) / V	an answer 400 gains **2** marks an answer 400 kilovolts / kV gains **3** marks although the unit mark is independent to gain **3** marks it must be consistent with the numerical value	1
7(b)	any **one** from: • (so that there is) no short circuit • (so that the) current goes round the coil • (so that the) current does not enter the core	do **not** accept any response in terms of heat insulation, safety or electric shock do **not** accept electricity for current	1

Question 7 continues on the next page

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PHY3H

Question 7 continues

question	answers	extra information	mark
7(c)	(the alternating p.d. in the primary causes) an (alternating) current in the primary	reference to the current in the core negates this mark	1
	(causes an) <u>alternating / changing</u> (magnetic) field in the (iron) core		1
	<u>induces</u> (alternating) p.d. across the <u>secondary</u> (coil)	accept in / through or similar for across accept current for p.d. accept output (coil) for secondary (coil) to gain **3** marks the sequence must be correct	1
Total			**7**

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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	

General Certificate of Secondary Education
Higher Tier
January 2011

Physics

PHY3H

Unit Physics P3

H

Written Paper

Wednesday 19 January 2011 9.00 am to 9.45 am

For this paper you must have:
- a ruler.

You may use a calculator.

Time allowed
- 45 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. 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 45.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

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

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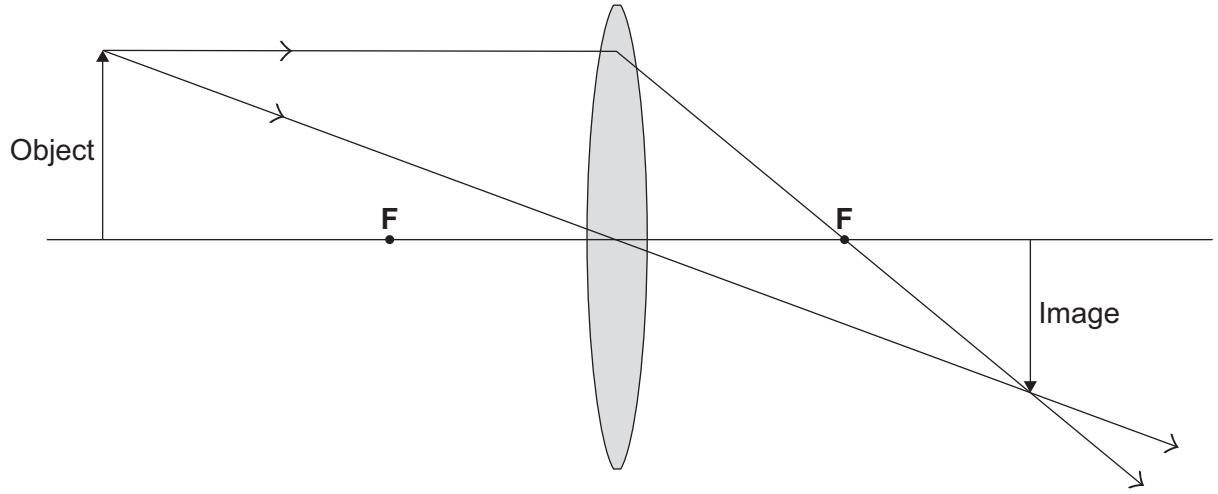
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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

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

1 The diagram shows a lens, the position of an object and the position of the image of the object.



1 (a) What type of lens is shown?

.....

(1 mark)

1 (b) What is the name of the points, **F**, shown each side of the lens?

.....

(1 mark)

1 (c) (i) The image is real and can be put on a screen.

How can you tell **from the diagram** that the image is real?

.....

.....

(1 mark)

1 (c) (ii) Draw a ring around a word in the box which describes the image produced by the lens.

inverted	**larger**	**upright**

(1 mark)

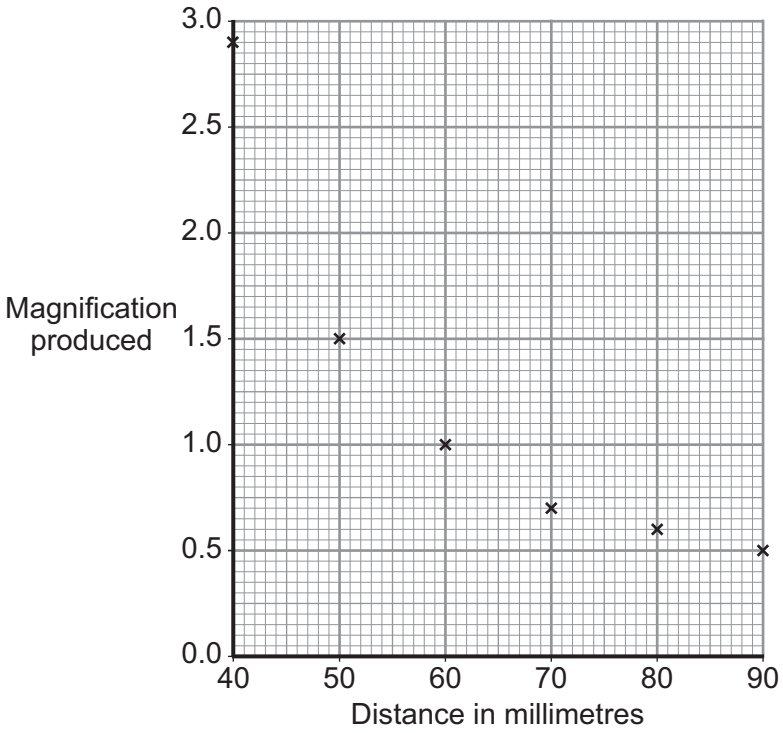
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1 (d) A student investigates the relationship between the distance from the object to the lens and the magnification produced by the lens.
The student's results are given in the table.
The student did not repeat any measurements.

Distance in millimetres	Height of object in millimetres	Height of image in millimetres	Magnification produced
40	20	58	2.9
50	20	30	1.5
60	20	20	1.0
70	20	14	0.7
80	20	12	0.6
90	20	10	0.5

The student plots the points for a graph of *magnification produced* against *distance*.



1 (d) (i) Draw a *line of best fit* for these points.

(1 mark)

Do not write outside the box

1 (d) (ii) Complete the following sentence by drawing a ring around the correct word in the box.

A line graph has been drawn because both variables are

described as being

categoric.
continuous.
discrete.

(1 mark)

1 (d) (iii) Describe the relationship between *magnification produced* and *distance*.

.....

.....

.....

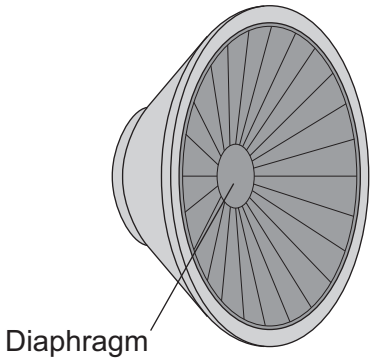
(2 marks)

8

Turn over for the next question

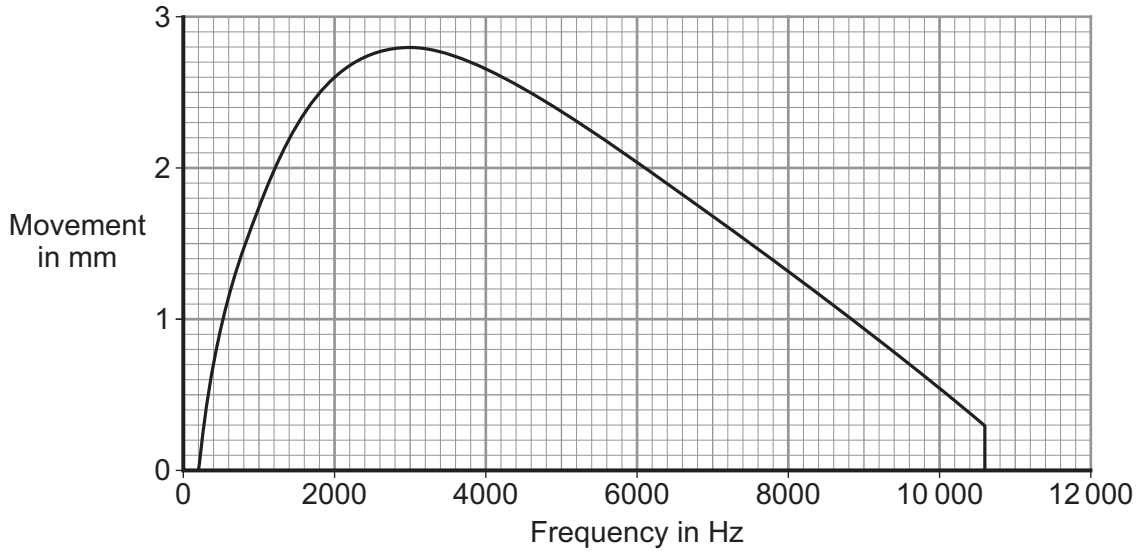
Do not write outside the box

2 The diaphragm of a loudspeaker moves in and out.



A team of scientists investigated loudspeakers.

The scientists measured the size of the movement of the diaphragm for signals of different frequencies.
They kept all the other variables constant.
The graph shows the average results for a large number of tests on one of the loudspeakers.



2 (a) What is the frequency of the highest pitched sound which this loudspeaker produces?

Frequency = ... Hz

(1 mark)

Do not write outside the box

2 (b) The greater the movement of the diaphragm, the greater the amplitude of the sound produced.

What is the frequency of the loudest sound which this loudspeaker produces?

Show clearly on the graph how you get to your answer and then complete this answer space.

Frequency = ... Hz

(2 marks)

2 (c) Can this loudspeaker produce the full range of sound which most people can hear?

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

Yes ☐ No ☐

Explain the reason for your answer.

.....

.....

.....

.....

(2 marks)

2 (d) Use **one** word to complete the sentence.

Repeating tests a large number of times and taking the average of the results

improves the ..... .

(1 mark)

2 (e) Why did the scientists keep all the other variables constant?

.....

.....

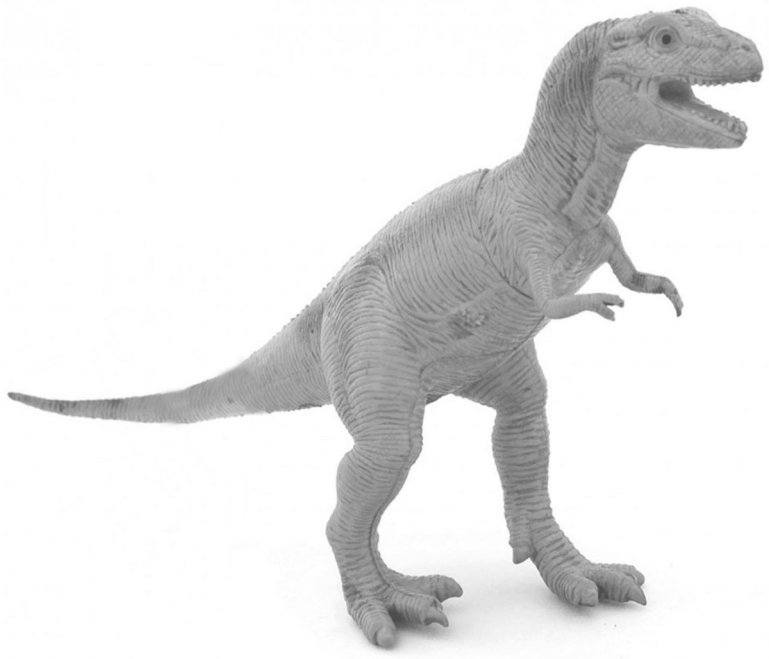
(1 mark)

7

Do not write outside the box

3 The drawing shows a plastic toy which can stand on its feet.

3 (a) (i) Draw an **X** on the diagram so that the centre of the **X** marks the likely position of the centre of mass of the toy.



(1 mark)

3 (a) (ii) Explain the reason for your choice in part **(a)(i)**.

.....

.....

(1 mark)

3 (b) Suggest **two** ways in which the design of the toy could be altered to make the toy more stable.

1 .....

.....

2 .....

.....

(2 marks)

4

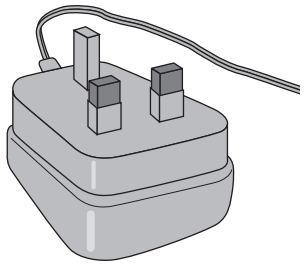
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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

4 (a) The drawing shows the plug for operating a radio from the mains.



This plug contains a transformer. There are 4600 turns on its primary coil and 200 turns on its secondary coil. The plug is used on the mains supply and has a potential difference (p.d.) of 230 V across its primary coil.

Use the equation in the box to calculate the p.d. across the secondary coil of the transformer.

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

Show clearly how you work out your answer.

.....

.....

.....

.....

p.d. across secondary = ... V

(2 marks)

4 (b) The coils of the transformer are made of insulated wire.

Why is the wire insulated?

.....

.....

(1 mark)

Do not write outside the box

4 (c) (i) What material is the core of a transformer made from?

.....

(1 mark)

4 (c) (ii) Why is the core made from this material?

.....

.....

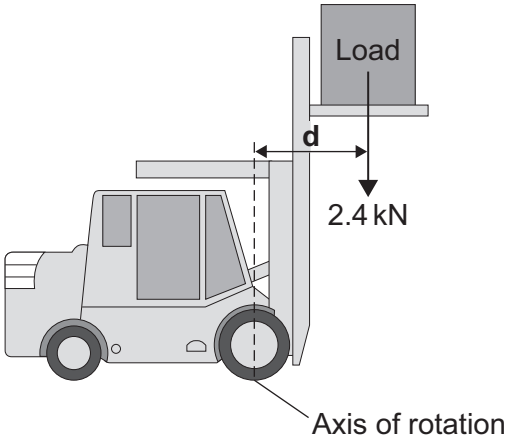
(1 mark)

5

Turn over for the next question

Do not write outside the box

5 The diagram shows a fork-lift truck with a load of 2.4 kN. The clockwise moment caused by this load is 2880 Nm.



5 (a) Use the equation in the box to calculate the distance **d**.

moment	=	force	×	perpendicular distance from the line of action of the force to the axis of rotation

Show clearly how you work out the answer and give the unit.

.....

.....

.....

Distance **d** = ...

(3 marks)

Do not write outside the box

5 (b) This warning notice is in the driver's cab.

Warning

Maximum load 10.0 kN

This load must not be exceeded

Explain in terms of moments why the maximum load must not be exceeded.

.....

.....

.....

.....

.....

.....

(2 marks)

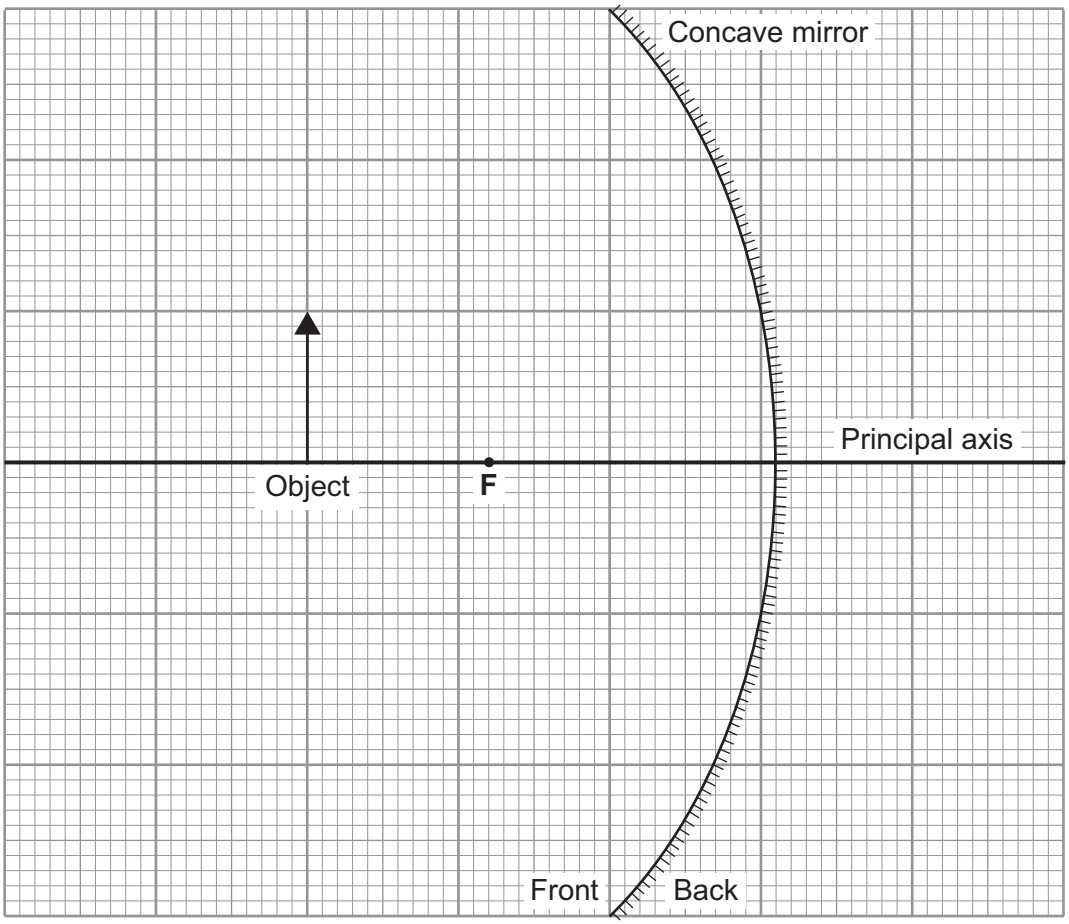
5

Turn over for the next question

Do not write outside the box

6 The diagram shows an object in front of a concave mirror.

Complete the diagram to show the position of the image.



(3 marks)

3

Do not write outside the box

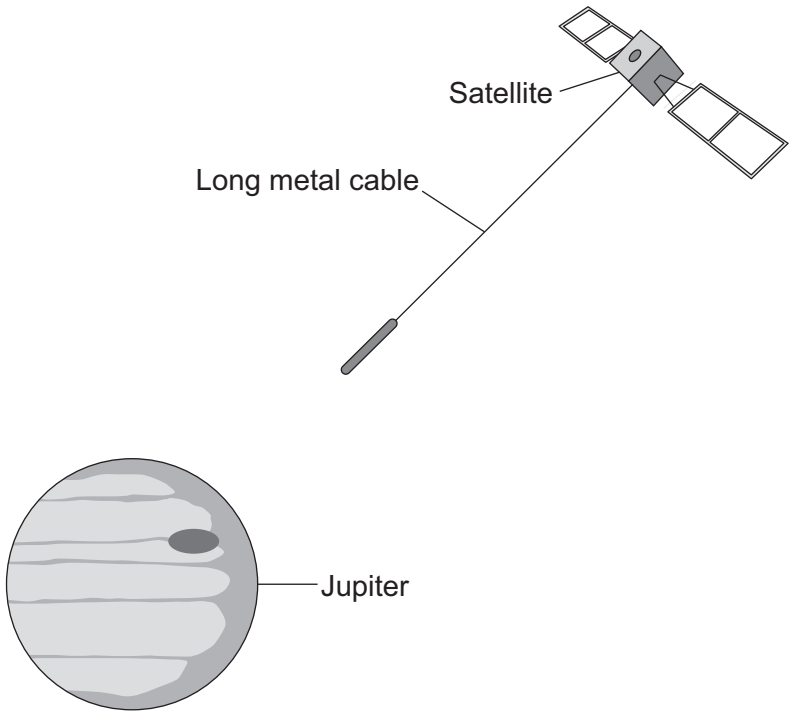
Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

7 Jupiter has a magnetic field which is more powerful than the magnetic field of any other planet in the Solar System.

Some scientists have suggested that, in the future, a long metal cable could hang from a satellite which orbits Jupiter. The cable would be part of a complete circuit. This arrangement would produce electricity for the satellite.



7 (a) (i) What is the name of the effect that would produce electricity for the satellite?

.....

(1 mark)

7 (a) (ii) Describe how a potential difference is produced across the ends of the metal cable.

.....

.....

.....

.....

(2 marks)

Do not write outside the box

7 (a) (iii) Why will the potential difference produce an electric current?

.....

.....

(1 mark)

7 (b) Other satellites in the Solar System could use the same effect to produce electricity in a similar way.

Suggest **two** reasons why the potential difference produced for another satellite might be **smaller** than the potential difference for the satellite in the diagram.

1 .....

.....

2 .....

.....

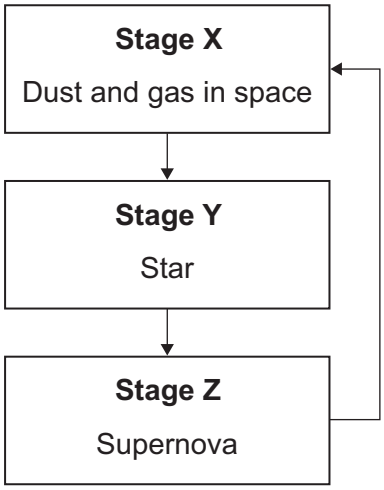
(2 marks)

6

Turn over for the next question

Do not write outside the box

8 The flowchart shows a simple version of the life cycle of a star that is much more massive than the Sun.



8 (a) What causes the change from **Stage X** to **Stage Y**?

.....

(1 mark)

8 (b) For most of its time in **Stage Y**, the star is stable.

Explain why the star remains stable.

.....

.....

.....

.....

(2 marks)

8 (c) (i) Explain how a star is able to produce energy in **Stage Y**.

.....

.....

.....

.....

(2 marks)

Do not write outside the box

8 (c) (ii) Why is a star in **Stage Y** able to give out energy for millions of years?

.....

.....

(1 mark)

8 (d) What happens to the elements produced in a supernova?

.....

.....

(1 mark)

7

END OF QUESTIONS

There are no questions printed on this page

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Version1.0: 24/02/2011

General Certificate of Secondary Education

Physics 4451

PHY3H Unit Physics 3

Mark Scheme

2011 Examination – January Series

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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 meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting 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 candidates' 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 to download from the AQA Website: www.aqa.org.uk

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Marking Guidance for Examiners

GCSE Science Papers

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 lines 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.

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

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

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

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, 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, as shown in the column 'answers', 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;

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.

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PHY3H

Question 1

question	answers	extra information	mark
1(a)	converging (lens)	accept 'convex (lens)' accept biconvex	1
1(b)	(principal) foci	accept 'focus' / 'focuses' / 'focis' focal point(s)	1
1(c)(i)	formed where (real) rays (of light) intersect / meet / cross	accept ray (of light) pass through the image accept 'image is on the opposite side (of the lens to the object)' accept (construction) lines cross over a response relating to a screen or similar is neutral lines are solid and not dotted is neutral	1
1(c)(ii)	inverted	accept any unambiguous correct indication	1
1(d)(i)	smooth curve which matches the points	judge by eye but do not accept point to point by ruler or otherwise	1
1(d)(ii)	continuous		1

Question 1 continues on the next page . . .

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PHY3H

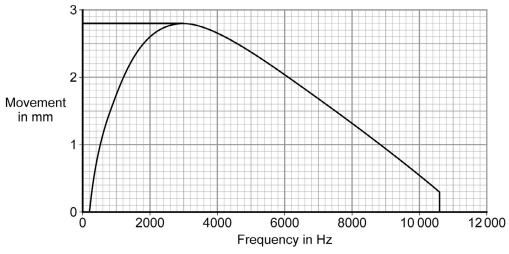
Question 1 continued . . .

question	answers	extra information	mark
1(d)(iii)	as distance increases, magnification decreases	accept negative correlation a statement 'inversely proportional' is incorrect and limits maximum mark for this part question to **1**	1
	further detail eg magnification falls steeply between 40 and 50 cm **or** magnification begins to level out after / at 70 cm		1
Total			**8**

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PHY3H

Question 2

question	answers	extra information	mark
2(a)	10 600 (Hz)	accept 10.6 kHz	1
2(b)	3000 (Hz)	allow **1** mark for a line drawn to show greatest movement (allow only if frequency is between 2800 and 3200) accept other indication of correctly using the graph  	2
2(c)	(No)	no marks for just the ticked box reasons can score even if yes is ticked	
	(human hearing) range is 20 – 20 000 (Hz)	accept (most) people hear up to 20 000 (Hz) / 20 kHz	1
	any **one** from: • range on graph is within / less than this range • range on graph starts after 20 Hz • range on graph is from to 200 – 10 600 (Hz) • range on graph finishes before 20 000 Hz		1

Question 2 continues on the next page . . .

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PHY3H

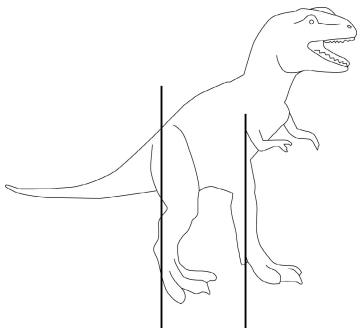
Question 2 continued . . .

question	answers	extra information	mark
2(d)	reliability	this answer only	1
2(e)	only 1 variable affects dependent variable / size of movement **or** there is only one independent variable **or** to be able to compare (effect of different frequencies)	accept 'results' for 'size of movement' fair test is insufficient do **not** accept to control the experiment	1
Total			**7**

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PHY3H

Question 3

question	answers	extra information	mark
3(a)(i)	centre of **X** above the feet and in the body	a vertical line from their **X** falls between two lines in diagram – judged by eye 	1
3(a)(ii)	where the mass seems to be concentrated	accept it's above the <u>base</u> (area) accept because otherwise it would topple accept line of action (of weight) passes through the <u>base</u> do **not** accept where the mass is concentrated	1
3(b)	any **two** from: • make (the area of) feet / base bigger • make feet wider apart • makes legs shorter / heavier • make head smaller / lighter • make tail touch the ground / make the tail longer	accept 'make centre of mass / gravity lower'	2
Total			**4**

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PHY3H

Question 4

question	answers	extra information	mark
4(a)	10	allow **1** mark for correct substitution ie $\frac{230}{Vs} = \frac{4600}{200}$	2
4(b)	any **one** from: • to prevent short circuiting • to ensure that the current flows / goes round the coil • to prevent the current entering the core	do **not** accept electrocution do **not** accept electricity for current answers including heat / energy loss negate mark	1
4(c)(i)	(soft) iron	do **not** accept 'steel'	1
4(c)(ii)	can be magnetised because it is magnetic	answers including it's a conductor negate mark	1
Total			**5**

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PHY3H

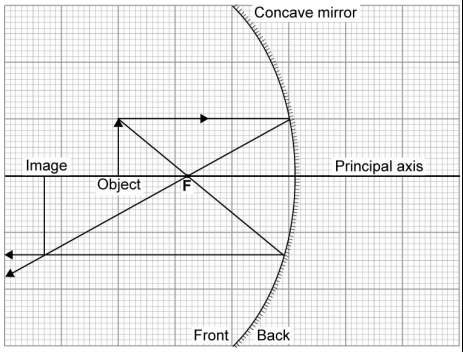
Question 5

question	answers	extra information	mark
5(a)	1.2 metre(s)/m	allow **1** mark for conversion of 2.4 kN to 2400 N or for correct transformation without conversion ie d = 2880 ÷ 2.4	2 1
5(b)	any **two** from: • as the load increases the (total) clockwise moment increases • danger is that the fork lift truck / the load will topple / tip forward • (this will happen) when the total clockwise moment is equal to (or greater than) the anticlockwise moment • (load above 10.0 kN) moves line of action (from C of M) outside base (area)	accept moments will not be balanced	2
Total			**5**

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PHY3H

Question 6

question	answers	extra information	mark
6	any **two** from: • straight line from the top of object parallel to principal axis then reflected from the mirror and through **F** • straight line from the top of the object through **F** to the mirror then reflected parallel to the principal axis • straight line from the top of the object to the centre of the mirror reflected so that angle of incidence = angle of reflection real image shown from where their reflected rays intersect and perpendicular to the principal axis	example of correct response  ignore direction of any arrow heads drawn on the lines ignore image orientation if shown	2 1
Total			**3**

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PHY3H

Question 7

question	answers	extra information	mark
7(a)(i)	generator (effect)	accept 'induction'	1
7(a)(ii)	(metal) cable is (an electrical) conductor (which) cuts / moves through the (magnetic) field (lines) / lines of force	mention of heat conduction negates this mark	1 1
7(a)(iii)	conductor / cable is part of a (complete) circuit	'it' refers to conductor	1
7(b)	any **two** from: • shorter cable • reduced speed • different planet (in the Solar System) • increased distance (from planet) • weaker magnetic field	 accept smaller cable accept smaller planet do **not** accept bigger planet do **not** accept smaller magnetic field Jupiter has the strongest magnetic field is insufficient	2
Total			**6**

STEMUP.CO.UK

PHY3H

Question 8

question	answers	extra information	mark
8(a)	gravitational attraction	accept 'gravity' accept (nuclear) fusion	1
8(b)	radiation 'pressure' and gravity / gravitational attraction are balanced / in equilibrium **or** there is sufficient / a lot of hydrogen / fuel to last a very long time / for (nuclear) fusion	must be in correct context accept are equal and opposite do **not** accept 'equal' do **not** accept constant supply of hydrogen this mark only scores if linked to the supply of hydrogen / fuel reference to burning negates both marks	1 1
8(c)(i)	(conversion of) hydrogen to helium by (nuclear) fusion	accept (conversion of) lighter elements to heavier elements note do **not** credit spelling of 'fusion' which could be 'fission' reference to burning negates both marks	1 1
8(c)(ii)	massive supply / lots of hydrogen		1
8(d)	distributed throughout the Universe / space	do **not** accept Solar System for Universe	1
Total			**7**

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

General Certificate of Secondary Education
Higher Tier
June 2010

Physics

PHY3H

H

Unit Physics P3

Written Paper

Friday 28 May 2010 9.00 am to 9.45 am

For this paper you must have:
- a ruler.

You may use a calculator.

Time allowed
- 45 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. 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 45.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

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

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Do not write outside the box

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

1 (a) A student finds data on the Internet for her project on the Solar System. She checks this data on other websites.

The table shows the checked data.

Name of planet	Diameter in km	Distance from Sun in millions of km	Period in days
Mercury	4840	58	87
Venus	12390	108	224
Earth	12760	149	365
Mars	6800	228	686
Jupiter	142800	778	4332
Saturn	119400	1428	10759
Uranus	47600	2870	30685
Neptune	48400	4497	60190

1 (a) (i) In the table, the period of each planet is given in days.

What is meant by the *period* of a planet?

.....

(1 mark)

1 (a) (ii) Suggest why the student checks the data on other websites.

.....

.....

(1 mark)

1 (a) (iii) What is the relationship, if any, between a planet's distance from the Sun and its period?

.....

.....

(1 mark)

Do not write outside the box

1 (a) (iv) What is the relationship, if any, between a planet's diameter and its period?

.....

.....

(1 mark)

1 (b) What is the force which provides the centripetal force to keep planets in their orbits?

.....

(1 mark)

1 (c) What is the name of the galaxy which contains the Solar System?

.....

(1 mark)

1 (d) Complete the following sentence by drawing a ring around the correct word in the box.

The universe is made up of

hundreds
thousands
millions
billions

of galaxies. *(1 mark)*

7

Turn over for the next question

Do not write outside the box

2 (a) Read this passage from a health leaflet.

> Most children can hear the full range of sounds which can be detected by the human ear. But as people get older, they cannot hear the higher frequencies.

2 (a) (i) Complete this statement.

Most children can detect sounds in the frequency range

..... Hz to ..... Hz.

(1 mark)

2 (a) (ii) What word is used to describe sound with a frequency so high that it cannot be heard by humans?

.....

(1 mark)

2 (b) Read this cutting from a newspaper.

> A shopkeeper has fitted a special loudspeaker outside his store.
> "We used to have gangs of young people out there," he said, "but now, when I switch on the special loudspeaker, they hate the sound and go away."
> Older people are not bothered by the sound because the frequency is too high for them to hear it.

Some people support the use of the special loudspeaker but other people do not.

Give **one** reason against its use.

.....

.....

(1 mark)

2 (c) Machines are often very noisy. They transfer energy, and some of the energy is transformed into sound.

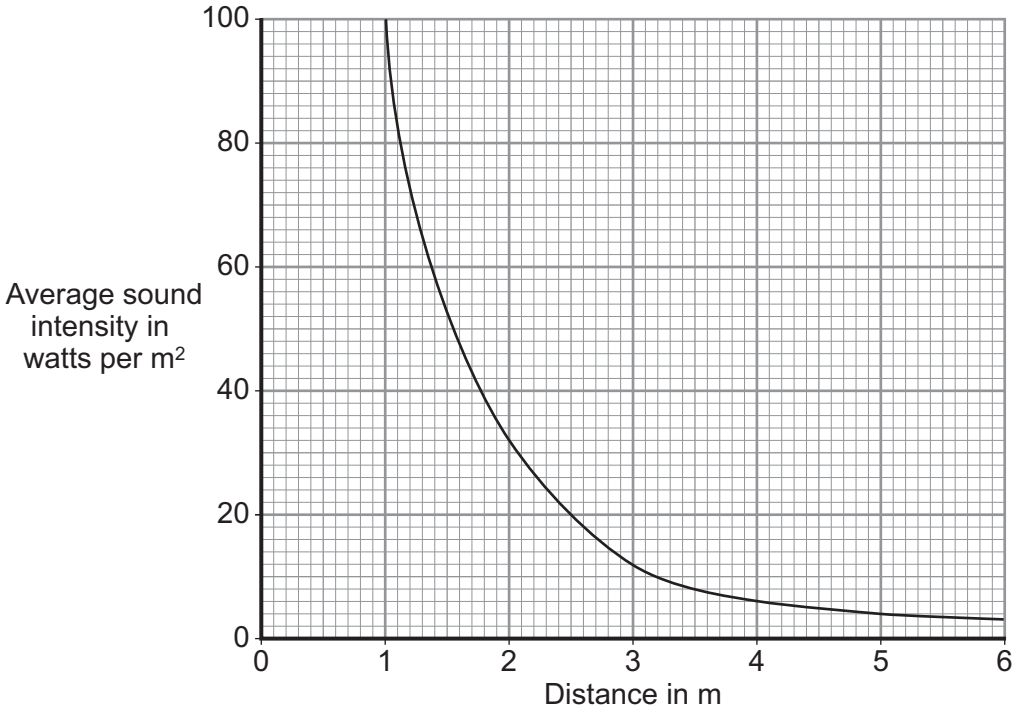
What is the cause of the sound?

.....

(1 mark)

Do not write outside the box

2 (d) Sound from a machine may damage the hearing of people who work close by. A safety officer measures the sound intensity at different distances from a noisy machine. The average results are shown on the graph.



2 (d) (i) Describe the pattern shown by the graph.

Use one or more examples from the graph to support your description.

.....

.....

.....

.....

(2 marks)

2 (d) (ii) Average results were plotted.

Explain why taking results several times and then calculating average values is more reliable than taking only a single result.

.....

.....

.....

.....

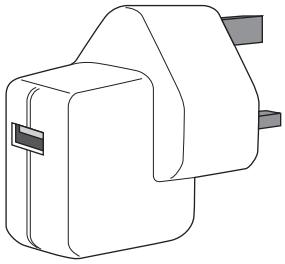
(2 marks)

8

Turn over ▶

Do not write outside the box

3 The diagram shows a USB power adapter which plugs into a 230 V a.c. mains socket.



The adapter contains a small step-down transformer.

3 (a) The core of the transformer is made of laminated soft iron.

Why is iron used?

.....

.....

(1 mark)

3 (b) The coils of the transformers are made of insulated copper wire.

Why is the wire insulated?

.....

.....

(1 mark)

Do not write outside the box

3 (c) There are 500 turns on one coil of the transformer and 20 000 turns on the other coil.

Use the equation in the box to calculate the p.d. across the secondary coil.

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

Show clearly how you work out your answer and give the unit.

.....

.....

.....

p.d. across the secondary = ...

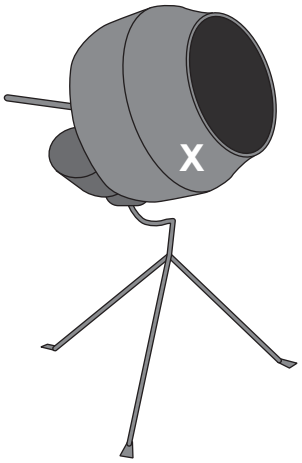
(3 marks)

5

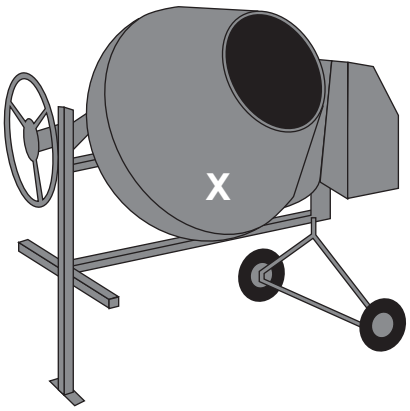
Turn over for the next question

Do not write outside the box

4 The diagrams show two concrete mixers.



Concrete mixer **A**



Concrete mixer **B**

On each diagram, the centre of the white **X** marks the centre of mass of the concrete mixer and its contents.

4 (a) Complete the sentence to explain what the term *centre of mass* means.

The centre of mass of a concrete mixer and its contents is .....

.....

..... .

(1 mark)

4 (b) Both diagrams are drawn to the same scale.

Concrete mixer **B** is more stable than concrete mixer **A**.

The two features which make concrete mixer **B** more stable are:

1 .....

.....

2 .....

.....

(2 marks)

Do not write outside the box

4 (c) Use the terms 'line of action of the weight' and 'resultant moment' to explain why a stable concrete mixer does not fall over when it is given a small push.

.....

.....

.....

.....

.....

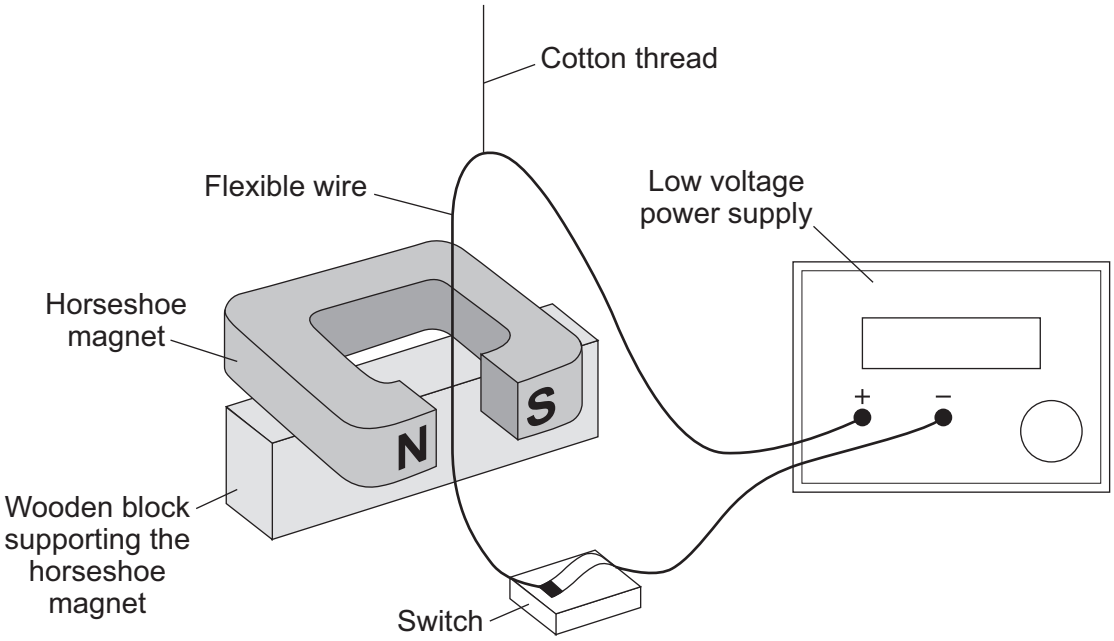
(2 marks)

5

Turn over for the next question

Do not write outside the box

5 (a) A laboratory technician sets up a demonstration.



A flexible wire is suspended between the ends of a horseshoe magnet. The flexible wire hangs from a cotton thread. When the switch is closed, the wire kicks forward.

Identify the effect which is being demonstrated.

.....

(1 mark)

Do not write outside the box

5 (b) A teacher makes some changes to the set-up of the demonstration.

What effect, if any, will each of the following changes have?

5 (b) (i) A more powerful horseshoe magnet is used.

.....

.....

(1 mark)

5 (b) (ii) The connections to the power supply are reversed.

.....

.....

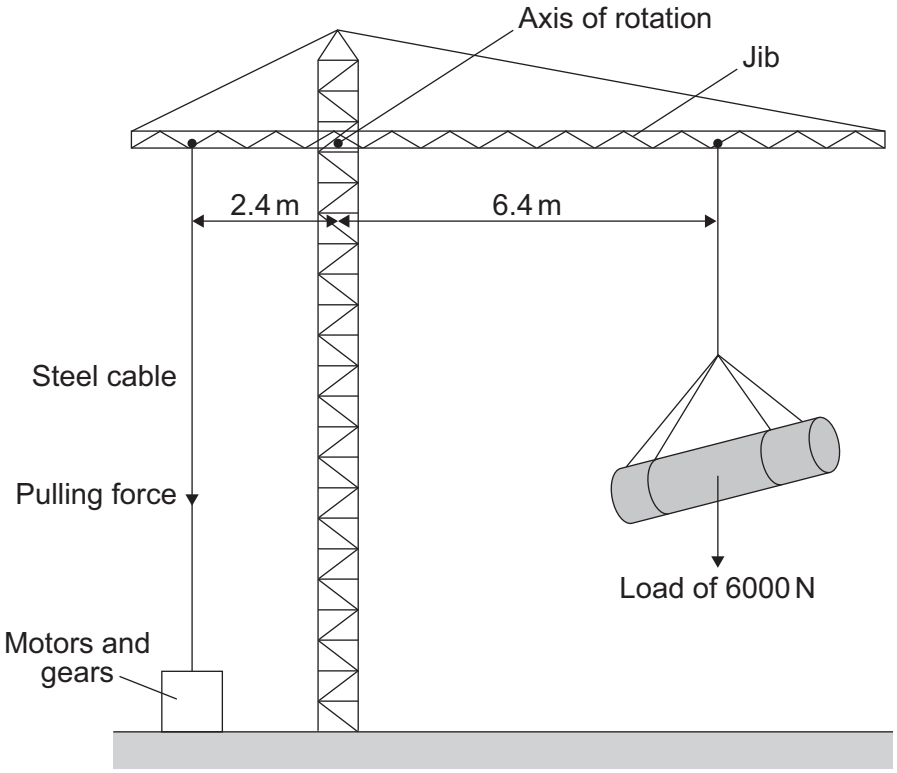
(1 mark)

3

Turn over for the next question

Do not write outside the box

6 The diagram shows a design for a crane. The crane is controlled by a computer.



The purpose of the motors and gears is to change the pulling force in the steel cable. This is done so that the jib stays horizontal whatever the size of the load or the position of the load.

Use the equation in the box to answer questions (**a**) and (**b**).

moment = force × perpendicular distance from the line of action of the force to the axis of rotation

6 (a) Calculate the moment caused by the load in the position shown in the diagram.

Show clearly how you work out your answer and give the unit.

.....

.....

Moment = ...

(3 marks)

Do not write outside the box

6 (b) Calculate the pulling force that is needed in the steel cable to keep the jib horizontal.

Show clearly how you work out your answer.

.....

.....

Pulling force = ... N

(2 marks)

5

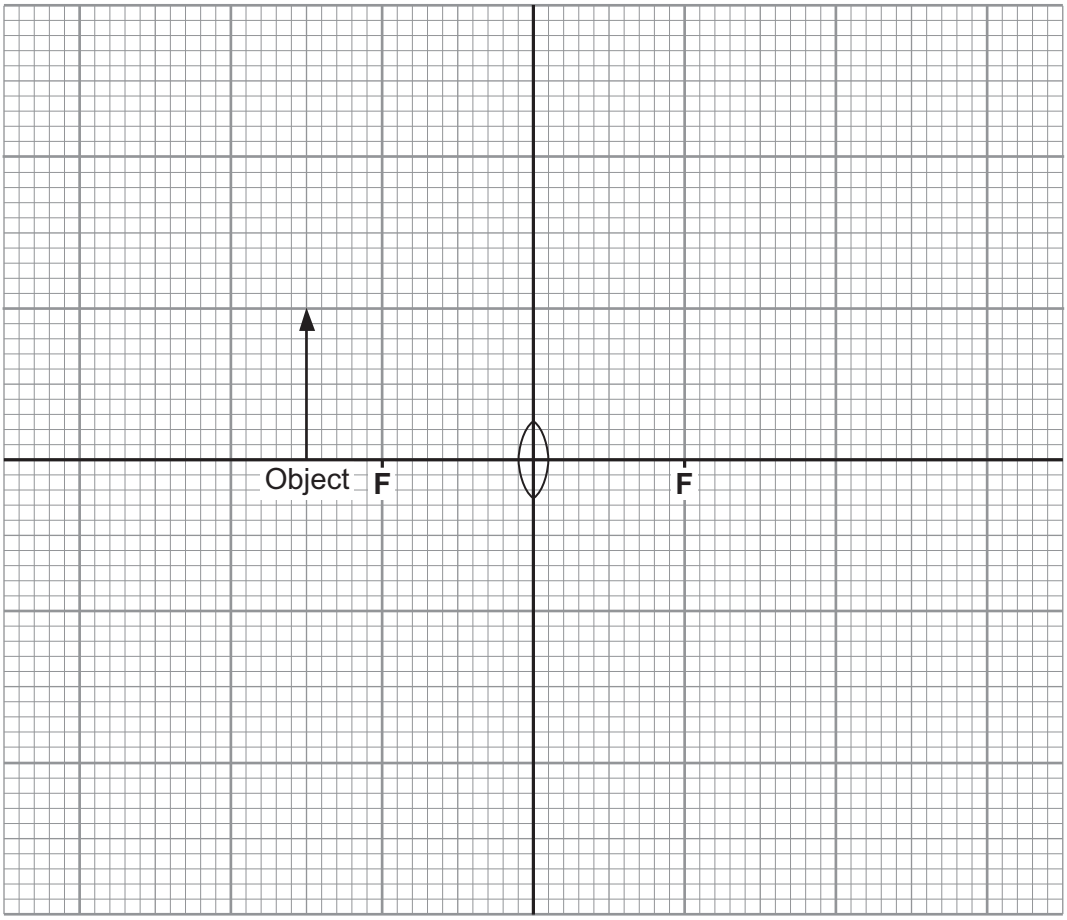
Turn over for the next question

Do not write outside the box

7 A student investigated how the nature of the image depends on the position of the object in front of a large converging lens.

The diagram shows one position for the object.

7 (a) Use a ruler to complete a ray diagram to show how the image of the object is formed.



Key: **F** = principal focus

(4 marks)

7 (b) Describe the nature of this image relative to the object.

.....

.....

.....

(2 marks)

6

Do not write outside the box

8 Every star goes through a 'life cycle'.

8 (a) Describe how a star forms.

.....

.....

.....

.....

.....

(2 marks)

8 (b) During a long period of its life, a star remains in a stable state.

Explain why a star remains stable.

.....

.....

.....

.....

.....

(2 marks)

8 (c) Some stars are much more massive than the Sun.

Describe what will happen to a star, originally much more massive than the Sun, after it reaches its red giant stage.

.....

.....

.....

.....

.....

(2 marks)

6

END OF QUESTIONS

There are no questions printed on this page

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Version : 29/07/2010

General Certificate of Secondary Education

Physics 4451

PHY3H Unit Physics 3

Mark Scheme

2010 Examination – June Series

STEMUP.CO.UK

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 meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting 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 candidates' 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 to download from the AQA Website: www.aqa.org.uk

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Marking Guidance for Examiners

GCSE Science Papers

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 lines 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	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

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

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, 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, as shown in the column 'answers', 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;

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 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use the **?** area in the CMI+ software to forward such answers to a Senior Examiner.

PHY3H

Question 1

question	answers	extra information	mark
1(a)(i)	time (for a planet) to orbit / go round the Sun	accept 'planet's year' accept time to rotate the Sun just 'year' is insufficient do **not** accept Earth year / time for Earth to orbit the Sun do **not** accept time for a planet to revolve any reference to distance negates the answer	1
1(a)(ii)	**either** information from the internet is not always reliable / accurate **or** data is (more) reliable (if it has been checked)	 accept to check it is correct / accurate / valid	1
1(a)(iii)	the greater the distance (from the Sun) the greater the (planet's) period	accept positive correlation accept if one increases then the other increases accept as distance increases it's longer do **not** accept they are (directly) proportional do **not** accept quicker period	1
1(a)(iv)	there is no relationship	accept 'none' / 'it is random' / 'no pattern'	1

Question 1 is continued on the next page . . .

PHY3H

Question 1 continued . . .

1(b)	(Sun's / star's) gravity		1
1(c)	(the) Milky Way	accept 'milky way'	1
1(d)	billions		1
Total			**7**

PHY3H

Question 2

question	answers	extra information	mark
2(a)(i)	20 (Hz) to 20 000 (Hz) / 20 kHz	**or** reversed order	1
2(a)(ii)	ultrasound / ultrasonic	do **not** accept sonic	1
2(b)	examples discriminates against (young) people who are not being a nuisance discriminates against young people (just) moves the group to another meeting place discourages young people from shopping distresses babies it's morally / ethically wrong	allow any reasonable response 'it bothers young people' is insufficient ignore reference to animals ignore damages hearing	1
2(c)	(mechanical) vibration	accept vibrations in the air / particles	1
2(d)(i)	the sound intensity gets (much) less the greater the distance from (the source of) the sound correct comparison from the graph eg sound is 100 (w/m²) at 1 (m) but only 20 (w/m²) at 2.5 (m)	allow the closer you are to the machine the more likely it is to damage your hearing accept the graph falls steeply (at first) and then more gently	1 1

Question 2 is continued on the next page . . .

PHY3H

Question 2 continued . . .

question	answers	extra information	mark
2(d)(ii)	any **two** from: • (so) data can be compared • anomalous results can be checked / removed / identified • more than one set of data • intensity / loudness fluctuates	increases reliability is insufficient improves accuracy is insufficient fair test is insufficient	2
Total			**8**

PHY3H

Question 3

question	answers	extra information	mark
3(a)	(it is) magnetic	**or** will carry (an alternating) magnetic field **or** magnetises and demagnetises (easily) reference to conduction negates the mark	1
3(b)	so the current / electricity does not flow through the iron / core	accept 'so the current / electricity / wires do not short (circuit)' responses in terms of heat insulation negate the mark ignore references to safety	1
3(c)	5.75 or 5.8 or 6(.0) V / volt(s)	allow for **1** mark **either** $\frac{230}{\text{p.d.}} = \frac{20\,000}{500}$ **or** p.d. = 230 ÷ 40	2 1
Total			**5**

PHY3H

Question 4

question	answers	extra information	mark
4(a)	the point at which the (total) mass seems to act / appears to be concentrated	accept 'weight' for 'mass' accept the point at which gravity seems to act do **not** accept a definitive statement eg where (all) the mass is	1
4(b)	wider / larger base lower centre of mass	marks are for a correct comparison accept lower centre of gravity / c of g	1 1
4(c)	line of action (of the weight) lies / falls inside the base the resultant moment returns mixer to its original position	in each case the underlined term must be used correctly to gain the mark accept there is no resultant moment / resultant moment is zero accept resulting moment for resultant moment do **not** accept converse argument	1 1
Total			**5**

PHY3H

Question 5

question	answers	extra information	mark
5(a)	motor (effect)		1
5(b)(i)	wire kicks further (forward)	accept moves for kicks accept moves more accept 'force (on the wire) increased'	1
5(b)(ii)	wire kicks back(wards) / into (the space in) the (horseshoe) magnet	accept moves for kicks accept 'direction of force reversed'	1
Total			**3**

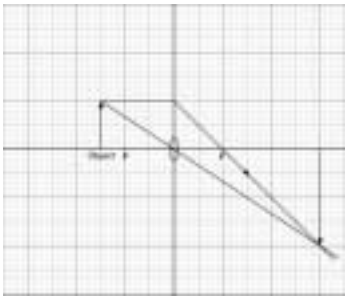
PHY3H

Question 6

question	answers	extra information	mark
6(a)	38 400 Nm **or** newton metres	allow 6.4 × 6000 for **1** mark do **not** credit 'nm', 'mN' or 'metre newtons'	2 1
6(b)	16 000 (N) **or** 16 kN	allow **1** mark for 38 400 ÷ 2.4 accept their (a) ÷ 2.4 correctly calculated for **2** marks accept their (a) ÷ 2.4 for **1** mark	2
Total			**5**

PHY3H

Question 7

question	answers	extra information	mark
7(a)	any **two** for **1** mark each ray from the object's arrowhead • through centre of lens • parallel to the axis then, when it reaches the lens, through F on the right • through F on the left then, when it reaches the lens parallel to the axis	deduct (1) from the first two marks if a ruler has not been used but the intention is clear example of a **4** mark response  if more than two construction lines have been drawn all must be correct to gain **2** marks construction lines drawn as dashed lines do not score credit	2
	image shown as vertical line from axis to where their <u>rays</u> intersect	image need not be marked with an arrowhead but, if it is, it must be correct	1
	ray direction shown	only one correct direction arrow needed but there must not be any contradiction	1
7(b)	any **two** from: • inverted • magnified • real	one correct feature gains **1** mark accept 'upside down' accept 'bigger' accept 'not virtual / not imaginary' ignore any reference to position an incorrect feature negates a correct response	2
Total			**6**

PHY3H

Question 8

question	answers	extra information	mark
8(a)	(enough) dust and gas (from space) pulled together by: • gravitational attraction **or** • gravitational forces **or** • gravity	accept nebula for dust and gas accept hydrogen for gas mention of air negates this mark	1 1
8(b)	forces (in the star) are balanced forces identified as gravity and radiation pressure	accept equal and opposite for balanced accept in equilibrium for balanced both forces are required gravitational forces inwards balance / equal radiation pressure outwards for **2** marks accept for **2** marks an answer in terms of sufficient hydrogen to keep the fusion reactions going accept for **1** mark an answer in terms of sufficient fuel to keep the fusion reactions going	1 1

Question 8 is continued on the next page . . .

PHY3H

Question 8 continued . . .

8(c)	(explodes as) a supernova		1
	any **one** from: • outer layer(s) thrown into space • scatters dust and gas into space (for the formation of new stars) • elements distributed throughout space • matter left behind / core may form a neutron star • a black hole will form if the gravitational forces are enormous / sufficient mass is left behind	do **not** accept just 'thrown into space' do **not** accept just 'dust and gas' do **not** accept just 'distributed' do **not** accept just 'neutron star' do **not** accept just 'black hole' do **not** accept any references to 'dark bodies' or 'black dwarfs' black hole forms if star is large enough is insufficient	1
Total			**6**

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
January 2010

Physics

PHY3H

Unit Physics P3

H

Written Paper

Wednesday 20 January 2010 9.00 am to 9.45 am

For this paper you must have:
- a ruler.

You may use a calculator.

Time allowed
- 45 minutes

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

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Areas outside the box will not be scanned for marking

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

1 A student collects data from the Internet about planets in the solar system.
She arranges the data into a table.

Name of the planet	Distance from the Sun in millions of kilometres	Time taken for one orbit of the Sun in years	Time taken to spin on its axis in hours	Average temperature on the side facing the Sun in ^{o}C
Mercury	60	0.24	1400	+430
Venus	110	0.60	5800	+470
Earth	150	1	24	+20
Mars	230	2	25	–20
Jupiter	780	12	10	–150
Saturn	1400	30	10	–180
Uranus	2900	84	17	–220
Neptune	4500	160	16	–230

1 (a) Name the **two** variables in the student's table which **always** have the relationship:

As one increases, so does the other.

..... and .....

(1 mark)

1 (b) (i) Give an example of **two** variables in the student's table which **generally** have the relationship:

As one increases, the other decreases.

..... and .....

(1 mark)

Areas outside the box will not be scanned for marking

1 (b) (ii) Which piece of data does not seem to fit the relationship in (b)(i)?

.....

(1 mark)

1 (c) Scientists plan to launch a satellite which will orbit Mars above its equator.
It will be a geostationary satellite.

How many hours will it take to orbit Mars?

..... hours

(1 mark)

1 (d) Mars has two moons.

Neither of them is in a geostationary orbit and they both take different times to orbit the planet.

Which **one** of these statements is correct.
Put a tick (✓) in the box next to your answer.

The two moons will always be above the same point on the surface of Mars. ☐

The two moons will be in different positions at different times. ☐

You can never see both moons at the same time. ☐

(1 mark)

1 (e) Use words from the box to complete the **three** spaces in the passage.

circular	**direction**	**friction**	**gravitational**	**speed**	**universal**

The moons of the planet Neptune move in circular paths around the planet.

They continuously accelerate towards the centre of Neptune.

The acceleration changes the ..... of each moon but does not change its ..... . The force causing the acceleration is a ..... force.

(2 marks)

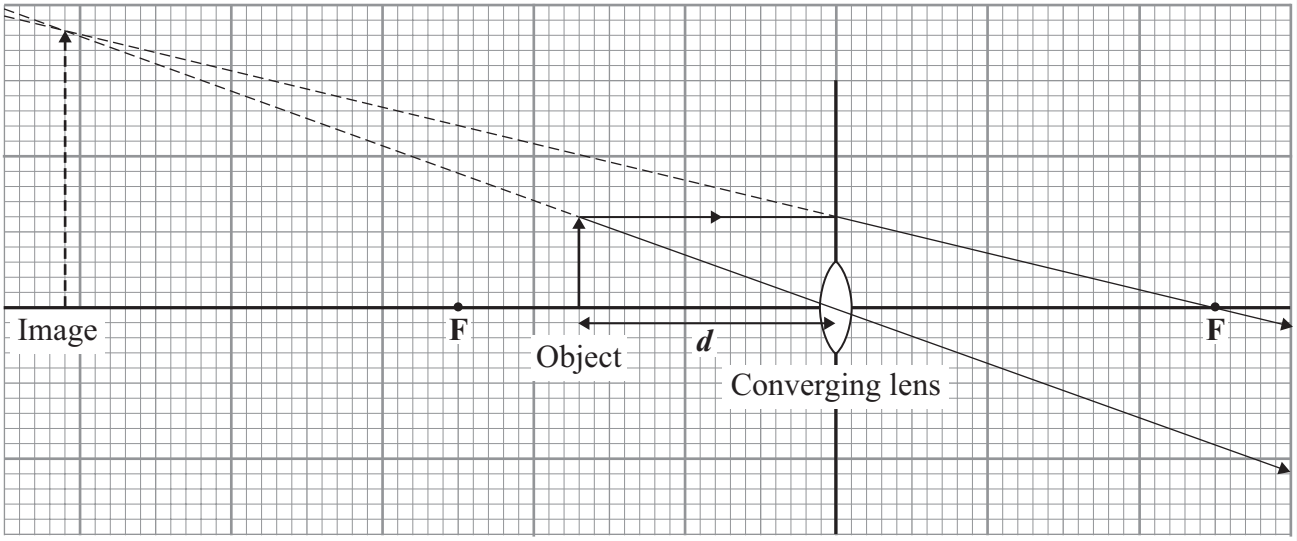
7

Turn over ▶

Areas outside the box will not be scanned for marking

2 A student investigates how the magnification of an object changes at different distances from a converging lens.

The diagram shows an object at distance ***d*** from a converging lens.



2 (a) (i) The height of the object and the height of its image are drawn to scale.

Use the equation in the box to calculate the magnification produced by the lens shown in the diagram.

$$\text{magnification} = \frac{\text{image height}}{\text{object height}}$$

Show clearly how you work out your answer.

.....

.....

.....

Magnification = ...

(2 marks)

2 (a) (ii) The points **F** are at equal distances on either side of the centre of the lens.

State the name of these points.

.....

(1 mark)

Areas outside the box will not be scanned for marking

2 (a) (iii) Explain how you can tell, **from the diagram**, that the image is virtual.

.....

.....

(1 mark)

Question 2 continues on the next page

Areas outside the box will not be scanned for marking

2 (b) The student now uses a different converging lens. He places the object between the lens and point **F** on the left.

The table shows the set of results that he gets for the distance ***d*** and for the magnification produced.

Distance *d* measured in cm	**Magnification**
5	1.2
10	1.5
15	2.0
20	3.0
25	6.0

His friend looks at the table and observes that when the distance doubles from 10 cm to 20 cm, the magnification doubles from 1.5 to 3.0.

His friend's conclusion is that:

The magnification is directly proportional to the distance of the object from the lens.

His friend's observation is correct but his friend's conclusion is **not** correct.

2 (b) (i) Explain, with an example, why his friend's conclusion is **not** correct.

.....

.....

.....

.....

(2 marks)

2 (b) (ii) Write a correct conclusion.

.....

.....

(1 mark)

Areas outside the box will not be scanned for marking

2 (b) (iii) The maximum range of measurements for ***d*** is from the centre of the lens to **F** on the left.

The student **cannot** make a correct conclusion outside this range.

Explain why.

.....

.....

(1 mark)

8

Turn over for the next question

Areas outside the box will not be scanned for marking

3 (a) Explain what an ultrasound wave is.

.....

.....

.....

.....

(2 marks)

3 (b) Ultrasound waves can be used to clean jewellery.

One method is to put the jewellery in a bath of cleaning fluid which contains an electronic oscillator. The electronic oscillator generates ultrasound waves in the cleaning fluid.

Suggest how these waves clean the jewellery.

.....

.....

.....

.....

(2 marks)

3 (c) Ultrasound is used for pre-natal scanning. This is much safer than using X-rays. However, doctors were only sure it was safe after experiments on mice.

Explain whether or not you think that these experiments were justified.

.....

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.....

.....

(2 marks)

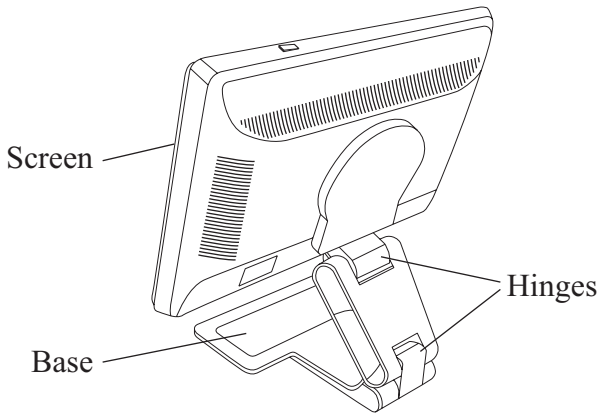
6

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Areas outside the box will not be scanned for marking

4 The diagram shows a back view of a computer monitor.



4 (a) In normal use, the monitor is *stable.*

4 (a) (i) Explain the meaning, in the above sentence, of the word *stable*.

.....

.....

.....

.....

(2 marks)

4 (a) (ii) State the relationship between the total clockwise moment and the total anticlockwise moment about any axis of the monitor when it is stable.

.....

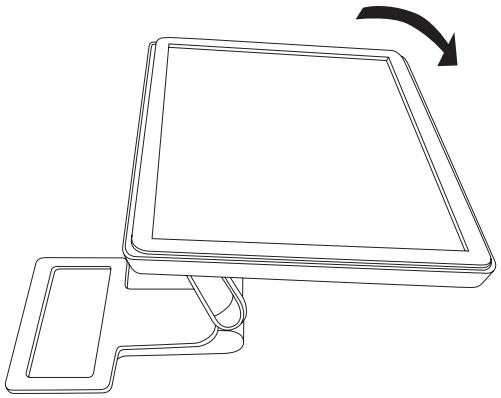
.....

(1 mark)

Areas outside the box will not be scanned for marking

4 (b) The instruction booklet explains that the screen can be tilted.
It also includes a warning.

Caution
The monitor can tip over if the screen is tilted too far back.



Explain why the monitor will tip over if the screen is tilted too far back.

Include the words *centre of mass*, *weight* and *moment* in your explanation.

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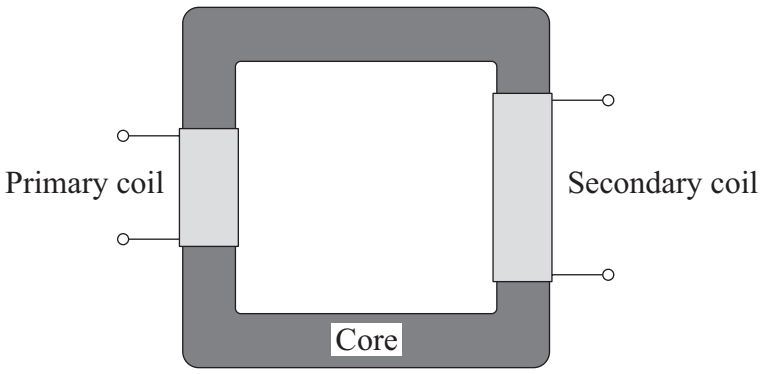
(3 marks)

6

Turn over for the next question

Areas outside the box will not be scanned for marking

5 (a) The diagram shows the basic structure of a step-up transformer.



5 (a) (i) What is the core made of?

.....

(1 mark)

5 (a) (ii) Explain how an alternating input produces an alternating output.

.....

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.....

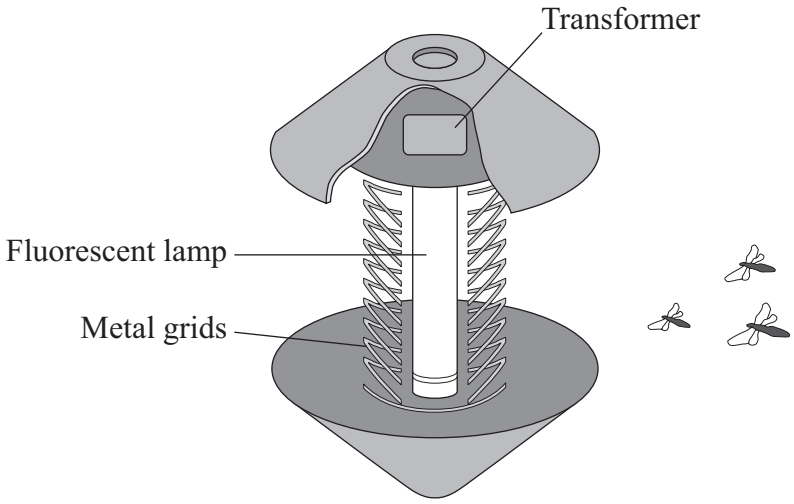
.....

(3 marks)

Areas outside the box will not be scanned for marking

5 (b) Fly killers are used in kitchens and food stores because flying insects carry diseases which cause food poisoning.

The diagram shows the inside of one design. Insects are attracted to a fluorescent lamp. The metal grids have a high potential difference (p.d.) between them. The insects are killed as they fly between the grids.



A transformer is used in the fly killer. There is a p.d. of 230 V across the primary coil. There are 300 turns of wire on the primary coil and 4000 turns on the secondary coil.

Use the equation in the box to calculate the p.d. across the secondary coil.

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

Show clearly how you work out your answer.

.....

.....

.....

.....

.....

Potential difference = ...V

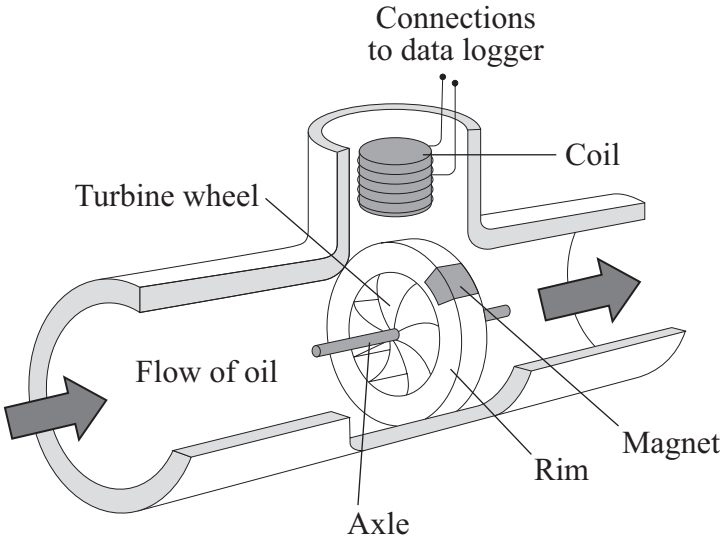
(3 marks)

7

Turn over ▶

Areas outside the box will not be scanned for marking

6 The diagram shows the inside of an oil pipeline and a student's design for a meter to measure the flow of oil.



As oil flows through the pipeline, the oil rotates a turbine wheel. Above the turbine wheel is a coil of wire connected to a data logger. There is a magnet in the rim of the turbine wheel. The turbine wheel spins and this induces a varying potential difference (p.d.) across the ends of the coil. This varying p.d. is recorded by the data logger.

6 (a) Complete the sentence by writing in the space.

The faster the oil flows through the pipeline, the ..... the maximum p.d. across the coil.

(1 mark)

6 (b) Explain why a varying p.d. is induced across the coil even when the rate of flow of oil remains constant.

.....

.....

.....

.....

.....

.....

(3 marks)

Areas outside the box will not be scanned for marking

6 (c) Suggest **two** changes to the design of the meter which would increase the maximum p.d. across the coil for the same flow of oil.

Change 1 .....

.....

Change 2 .....

.....

(2 marks)

6

Turn over for the next question

Areas outside the box will not be scanned for marking

7 (a) Our star, the Sun, is stable.

Explain what the conditions need to be for a star to remain stable.

.....

.....

.....

.....

.....

.....

(2 marks)

7 (b) Shortly after the 'big bang', hydrogen was the only element in the Universe.

Explain how the other elements came to be formed.

.....

.....

.....

.....

.....

.....

.....

.....

(3 marks)

5

END OF QUESTIONS

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Version : 24/02/2010

General Certificate of Secondary Education

Physics 4451

PHY3H Unit Physics 3

Mark Scheme

2010 examination - January series

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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 meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting 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 candidates' 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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Dr Michael Cresswell Director General

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 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 lines 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.

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

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

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

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, 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, as shown in the column 'answers', 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;

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.

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PHY3H

Question 1

question	answers	extra information	mark
1(a)	distance (from the Sun in millions of km) and time taken for orbit	both required in either order **not** just 'time taken'	1
1(b)(i)	**either** distance (from the Sun in millions of km) **or** time taken for orbit (and) (average) temperature	 **not** just 'time taken' both required in either order	1
1(b)(ii)	(+) 430 / (+) 470 **or** Mercury / Venus		1
1(c)	25 (hours)	do **not** accept 24 (hours)	1
1(d)	...different positions at different times		1
1(e)	…direction…speed gravitational	both and in the correct order	1 1
Total			**7**

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PHY3H

Question 2

question	answers	extra information	mark
2(a)(i)	answer in the range 3.0 ↔ 3.1 inclusive	accept for 1 3.6 ÷ 1.2 or 3.7÷1.2 or 36 ÷ 12 or 37÷12 or 18 ÷ 6 or 18.5 ÷ 6 or 10.2 ÷ 3.4 or 102 ÷ 34 or answer in the range but with a unit eg 3 cm	2
2(a)(ii)	(principal) focus / focal (point(s)) / foci / focus	accept 'focusses' accept focals do **not** accept focal length	1
2(a)(iii)	at the intersection of virtual / imaginary rays	**or** 'where virtual / imaginary rays cross' **or** the rays of (real) light do not cross **or** the image on the same side (of the lens) as the object **or** the image is drawn as a dotted line **or** the image is upright do **not** accept 'cannot be put on a screen' do **not** accept any response which refers to reflected rays	1

Question 2 continues on the next page . . .

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PHY3H

Question 2 continued . . .

question	answers	extra information	mark
2(b)(i)	another correct observation about relationship between values of **d** (1) (but) not the same relationship between corresponding values for magnification (1)	**example** 15 is three times bigger than 5 but 2.0 is not three times bigger than 1.2	2
2(b)(ii)	when the distance / **d** increases the magnification increases	**or** the converse accept 'there is a (strong) positive correlation' do **not** accept any response in terms of proportion / inverse proportion	1
2(b)(iii)	(student has) no evidence (outside this range)	accept data / results / facts for 'evidence'	1
Total			**8**

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PHY3H

Question 3

question	answers	extra information	mark
3(a)	sound / mechanical / longitudinal (wave) any **one** from: • above 20 000 hertz / 20kHz • above (human) audible range • cannot be heard by humans		1 1
3(b)	**either** particles / molecules / fluid vibrate(s) (1) (and) knock particles of dirt off the jewellery (1) **or** by the process of cavitation (1) which breaks up / releases dirt from the surface (1)	 accept 'formation and collapse of tiny bubbles'	2

Question 3 continues on the next page . . .

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PHY3H

Question 3 continued . . .

question	answers	extra information	mark
3(c)	**either** two appropriate points gain **1** mark each **or** one appropriate point (and) appropriate qualification / amplification	**either** both pro **or** both con **or** one of each examples other mammals (sufficiently) similar to humans (1) so results appropriate (1) unethical to experiment on humans (1) so it is better to experiment on mice (1) knowledge / techniques will benefit humans (1) and also other animals (1) experiments were justified because ultrasound has proved useful (1)	2
Total			**6**

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PHY3H

Question 4

question	answers	extra information	mark
4(a)(i)	will not fall over (1) **or** centre of mass will remain above the base (1) if the monitor is given a small push (1)	accept will not easily fall over (2) (line of action of the) weight will remain above within the base accept centre of gravity / c of g / c of m / c m depends on mark above	2
4(a)(ii)	(total) clockwise moment = (total) anticlockwise moment	**or** they are equal / balanced	1
4(b)	the position of the centre of mass has changed (1) the line of action of the weight is outside the base (1) producing a (resultant) moment (1)	points may be expressed in any order	3
Total			**6**

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PHY3H

Question 5

question	answers	extra information	mark
5(a)(i)	(laminated soft) iron	do **not** accept steel	1
5(a)(ii)	produces a magnetic field which is alternating / changing / varying and which induces / produces an alternating / changing potential difference across the secondary coil	accept magnetic flux accept current / voltage	3
5(b)	3067 (V)	allow all **3** marks for 3060 to 3070 (V) $V = \frac{230 \times 4000}{300}$ gains **2** marks $\frac{230}{V} = \frac{300}{4000}$ gains **1** mark	3
Total			**7**

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PHY3H

Question 6

question	answers	extra information	mark
6(a)	greater	accept bigger / larger / higher	1
6(b)	magnetic field / flux (1) cuts through the coil (1) p.d varies as the distance between magnet and coil changes / as the magnet rotates (1)	 **or** the converse accept voltage for p.d. accept varies for changes	3
6(c)	any **two** from: • move coil closer to the rim / wheel • more powerful magnet • more turns (on the coil) • coil with greater area • using an iron core	 **or** smaller gap between rim / wheel and coil accept extra magnets do **not** accept more coils	2
Total			**6**

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PHY3H

Question 7

question	answers	extra information	mark
7(a)	gravitational force(s) (1) balanced by (force(s) due to) <u>radiation</u> pressure (1)	accept 'gravity' accept equal	2
7(b)	by (nuclear) <u>fusion</u> (1) of hydrogen to helium (other light elements) (1) heavy element / elements heavier than iron are only produced (by fusion) in a <u>supernova</u> (1)	 allow 'low density' for light accept hydrogen nuclei / atoms form helium response must clearly link one element(s) producing others fusion to produce helium (2) allow dense for heavy ignore any reference to elements undergoing radioactive decay (to form other elements)	3
Total			**5**

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Surname		Other Names	
Centre Number			Candidate Number					
Candidate Signature								

For Examiner's Use

General Certificate of Secondary Education
June 2009

PHYSICS
Unit Physics P3

PHY3H

H

Higher Tier

Wednesday 10 June 2009 1.30 pm to 2.15 pm

For this paper you must have:
- a ruler

You may use a calculator.

Time allowed: 45 minutes

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

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

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

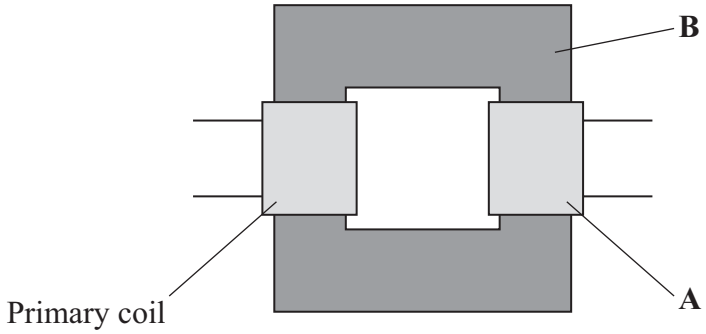
For Examiner's Use			
Question	Mark	Question	Mark
1		3	
2		4	
		5	
		6	
		7	
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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Areas outside the box will not be scanned for marking

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

1 (a) The diagram shows a transformer.



1 (a) (i) What is part **A**?

.....

(1 mark)

1 (a) (ii) What is part **B** and what is it made of?

.....

.....

(2 marks)

1 (a) (iii) When there is an alternating current in the primary coil, what is produced in part **B**?

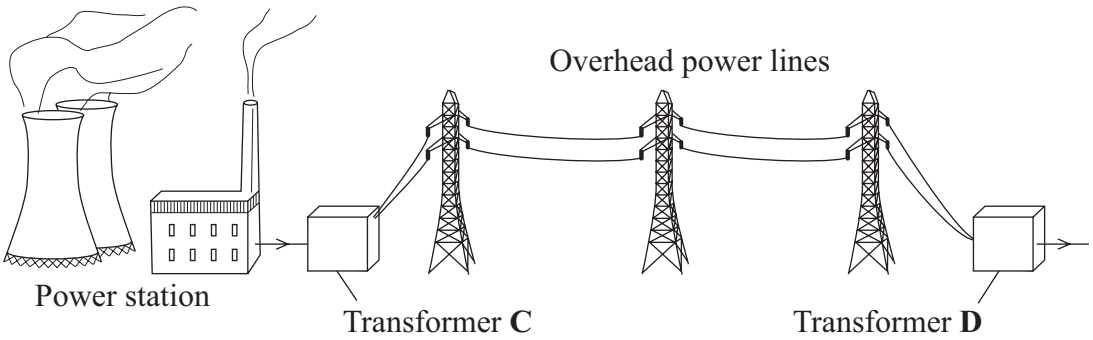
.....

.....

(2 marks)

Areas outside the box will not be scanned for marking

1 (b) Transformers are used in the National Grid. The diagram shows part of the National Grid.



Complete the **two** spaces in the sentence.

Transformer **C** is a ..... transformer and transformer **D** is

a ..... transformer. *(1 mark)*

1 (c) This is an item from a newspaper.

> **Health at risk from power lines?**
>
> Are high voltage power lines a health risk to people who live near them?
>
> Some scientists think that scientific evidence shows that they are.
>
> Other scientists do not think that the scientific evidence supports this conclusion.

Which **two** suggestions would reduce the possible risk to people's health?
Put a tick (✓) in the box next to your answers.

Do not build new houses near to existing power lines. ☐

Move the power lines so that they take the shortest routes. ☐

Move each power station to the centre of the nearest city. ☐

Build new power lines away from where people live. ☐

Use more transformers in the National Grid. ☐

(2 marks)

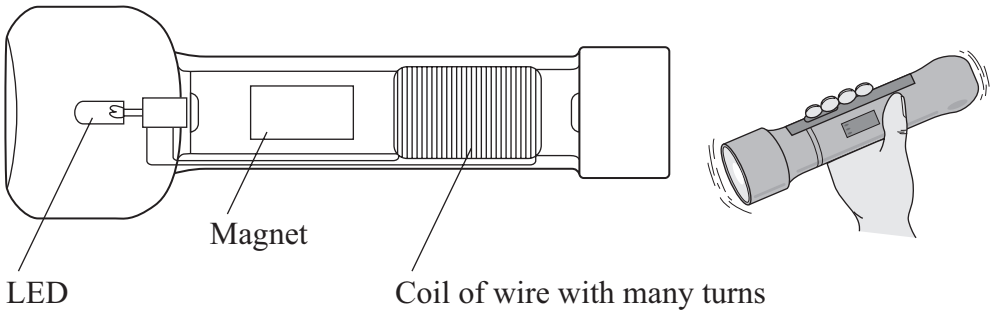
8

Turn over ▶

Areas outside the box will not be scanned for marking

2 The diagram shows some parts of a torch which works without batteries.
The coil is part of a complete circuit with the LED (light-emitting diode).

You have to shake the torch for a short time and then it is ready to use.



2 (a) Arrange the letters, **A**, **B**, **C**, **D** and **E**, in the correct order to explain how shaking the torch produces an electric current.

A An electric current is induced in the circuit.

B The magnetic field cuts through the coil.

C The magnet moves in and out of the coil.

D A potential difference (p.d.) is induced across the ends of the coil.

E The torch is shaken to and fro.

The first letter has been done for you.

E				

(2 marks)

2 (b) Give **two** changes which you would make to the design of the torch to increase the size of the induced potential difference.

1 .....

.....

2 .....

.....

(2 marks)

Areas outside the box will not be scanned for marking

2 (c) A few minutes after shaking, the LED gets dimmer and then stops giving out light.

A student tests the torch. She shakes it for a period of time. Then she switches it on and times how long the light lasts.

These are her results.

Period of time torch is shaken measured in seconds	**How long the light lasts measured in seconds**
30	168
60	312
90	420
120	546
150	654

2 (c) (i) What conclusion can the student come to on the basis of these results?

.....

.....

(1 mark)

2 (c) (ii) The student's friend says that the results are **not** reliable. Her friend is correct.

Give **two** reasons why.

1 .....

.....

.....

2 .....

.....

.....

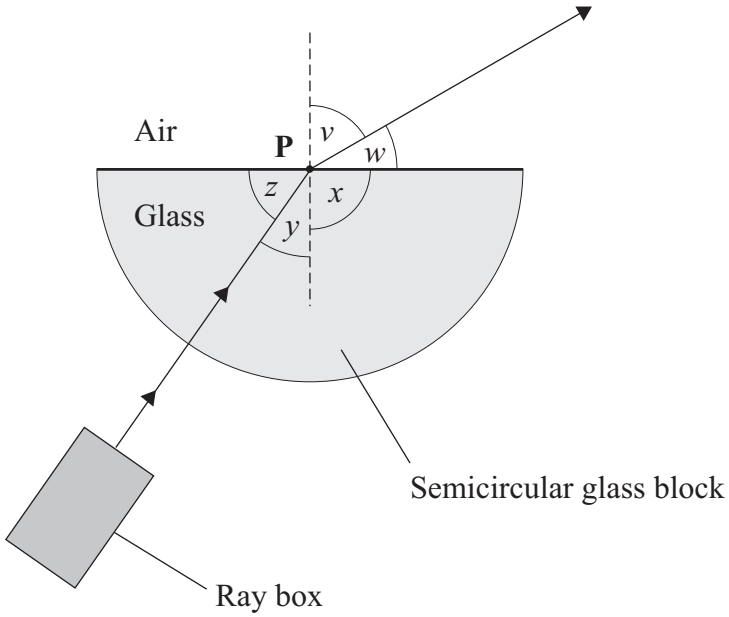
(2 marks)

7

Turn over ▶

Areas outside the box will not be scanned for marking

3 A student uses a ray box and a semicircular glass block to investigate refraction.



3 (a) What is the vertical dashed line called?

.....

(1 mark)

3 (b) Which angle, *v*, *w*, *x*, *y* or *z*, is the angle of refraction?

.....

(1 mark)

3 (c) Why has refraction taken place?

.....

.....

(1 mark)

Areas outside the box will not be scanned for marking

3 (d) In an investigation, a student always aims the light from the ray box at point **P**.
She moves the ray box to give different values of angle *v*.
She records angle *y* for each of these values. The table shows her results.

Angle *v* measured in degrees	**Angle *y* measured in degrees**
30	19
40	25
50	31
60	35
70	39
80	41

The student studies the data and comes to the following conclusion.

> Angle *y* is directly proportional to angle *v*.

Her friend says that this conclusion is **not** correct.

3 (d) (i) Use data from the table to explain why the conclusion is **not** correct.

.....

.....

(2 marks)

3 (d) (ii) Write a correct conclusion for the experiment.

.....

.....

(1 mark)

3 (d) (iii) Why is your conclusion only valid when angle *v* is between 30° and 80°?

.....

.....

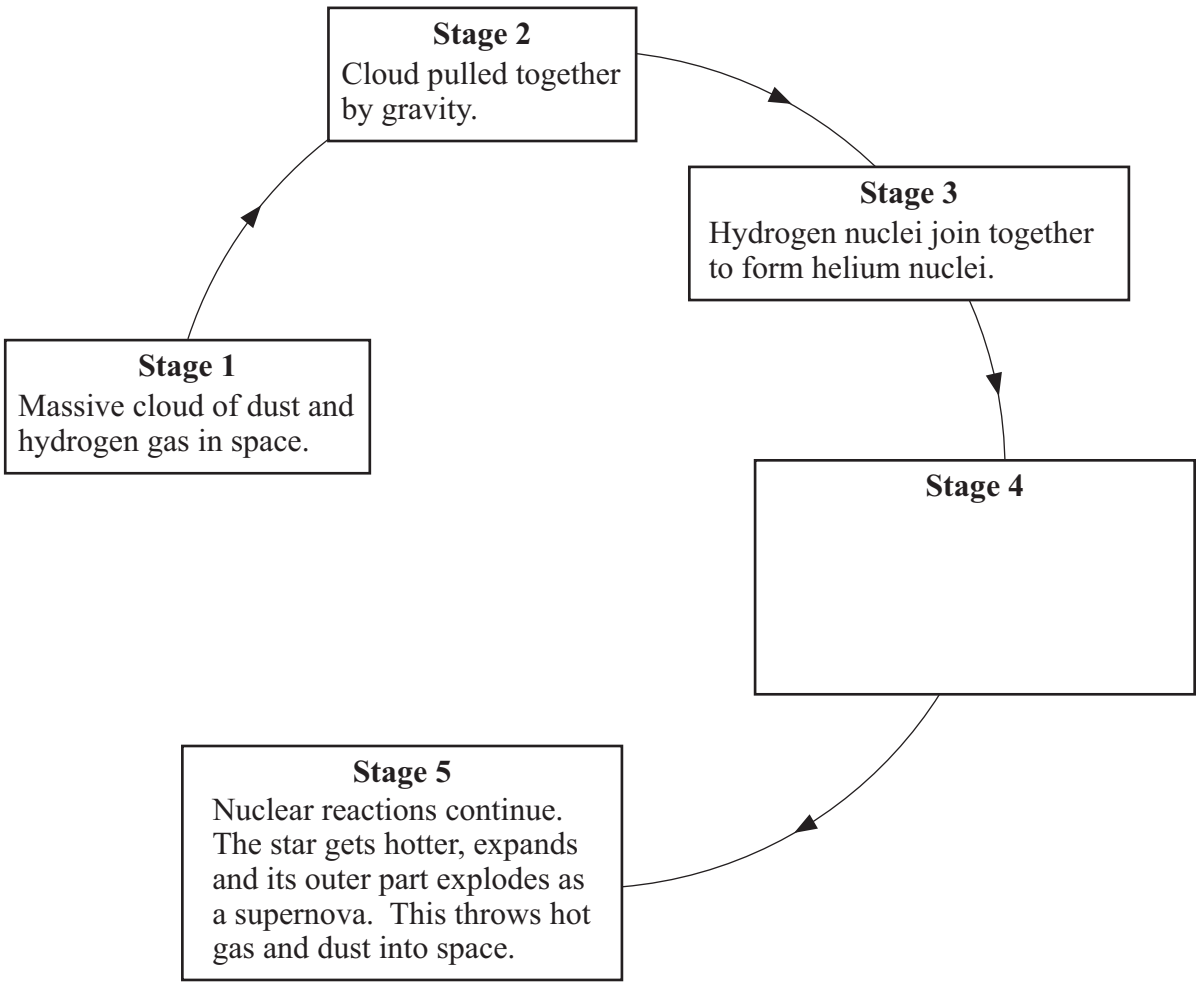
(1 mark)

7

Turn over ▶

Areas outside the box will not be scanned for marking

4 The diagram shows part of the life cycle of a star which is much bigger than the Sun.



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4 (a) (i) What is the relationship between the masses of the dust and gas in the cloud in **Stage 2** and the force of gravity between them?

.....

.....

(1 mark)

4 (a) (ii) What is the relationship between the distance apart of the dust and gas in the cloud in **Stage 2** and the force of gravity between them?

.....

.....

(1 mark)

4 (b) In **Stage 3** the star remains stable for millions of years.

Explain why.

.....

.....

.....

.....

.....

(2 marks)

4 (c) What happens in **Stage 4**?

.....

.....

.....

.....

.....

(2 marks)

6

Areas outside the box will not be scanned for marking

5 (a) The diagrams show oscilloscope traces for the same musical note played on two different instruments. The oscilloscope settings are not changed.

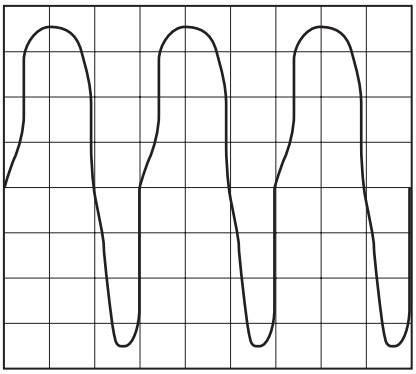


Diagram X

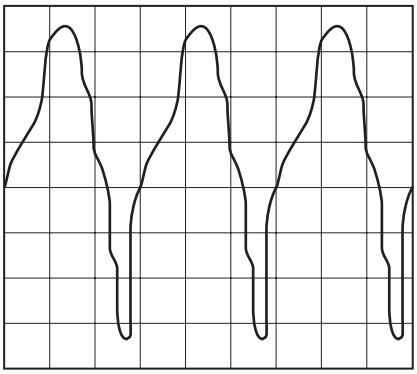


Diagram Y

5 (a) (i) How can you tell, from the diagrams, that it is the same musical note?

.....

.....

(1 mark)

5 (a) (ii) How can you tell, from the diagrams, that the musical note has been played on different instruments?

.....

.....

(1 mark)

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5 (b) This passage is from an electronics magazine.

> *Electronic systems can be used to produce ultrasound waves.*
> *These waves have a higher frequency than the upper limit for hearing in humans.*
> *Ultrasound waves are partially reflected when they meet a boundary between two different media.*

5 (b) (i) Approximately what is the highest frequency that humans can hear?
State the number and the unit.

.....

(1 mark)

5 (b) (ii) What does the word *media* mean when it is used in this passage?

.....

.....

(1 mark)

5 (b) (iii) What happens to the ultrasound which reaches the boundary between two different media and is **not** reflected?

.....

.....

.....

.....

(2 marks)

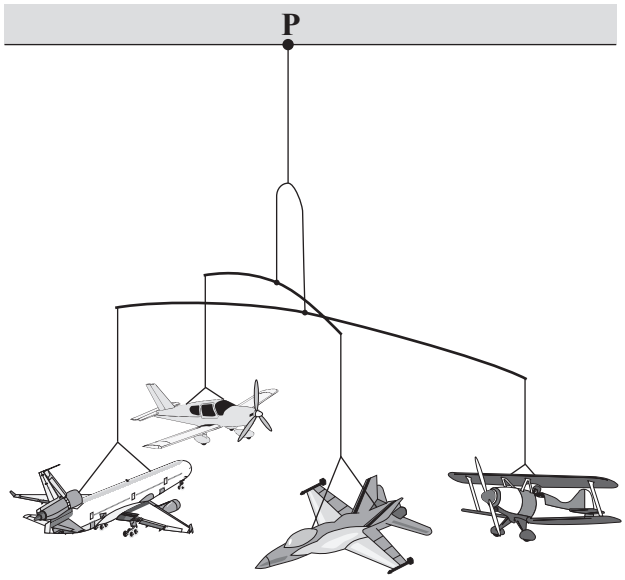
6

Turn over for the next question

Areas outside the box will not be scanned for marking

6 (a) The diagram shows a child's mobile. The mobile hangs from point **P** on the ceiling of the child's bedroom.

6 (a) (i) Mark the position of the centre of mass of the mobile by drawing a letter **X** on the diagram. Do this so that the centre of the **X** marks the centre of mass of the mobile.



(1 mark)

6 (a) (ii) Explain why you have chosen this position for your letter **X**.

.....

.....

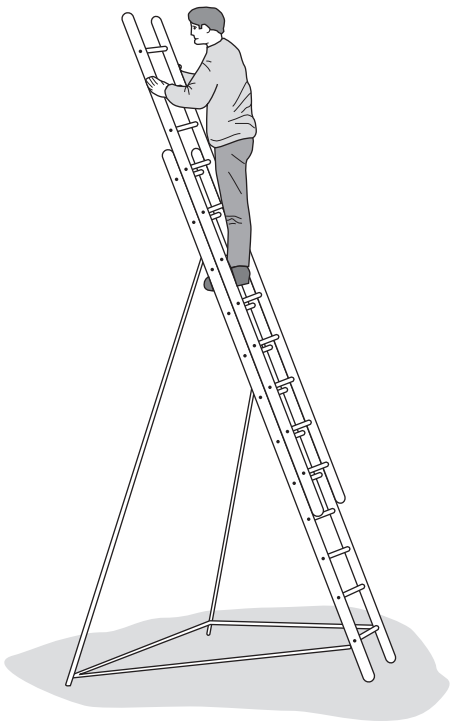
.....

.....

(2 marks)

Areas outside the box will not be scanned for marking

6 (b) The diagram shows a device which helps to prevent a ladder from falling over.



Use the term *centre of mass* to explain why the ladder, in the situation shown, is unlikely to topple over.
You may add to the diagram to illustrate your explanation.

.....

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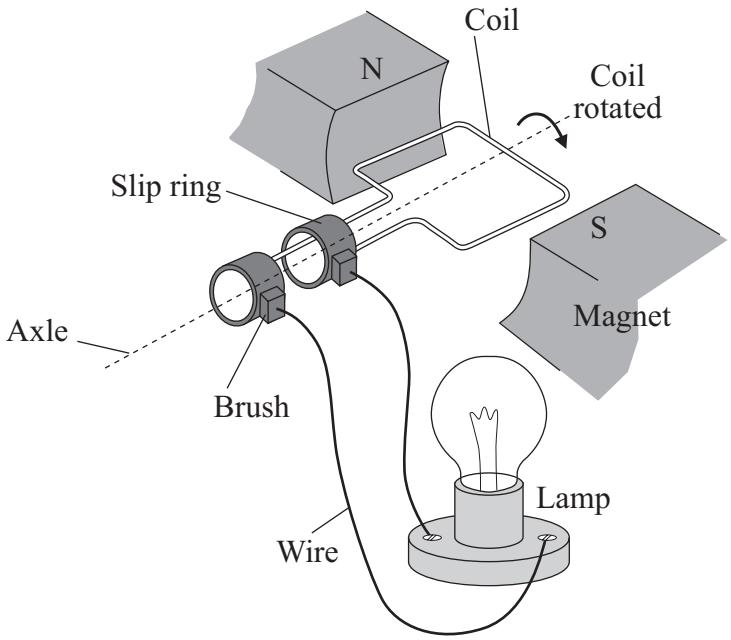
(3 marks)

6

Turn over ▶

Areas outside the box will not be scanned for marking

7 The diagram shows a generator.
When the coil is rotated around the axle, a current is produced and the lamp lights up.



7 (a) Explain the purpose of the slip rings and brushes.

.....

.....

.....

(2 marks)

7 (b) Explain how this generator gives an a.c. rather than a d.c. output.

.....

.....

.....

(2 marks)

7 (c) In this design, the generator effect occurs because the coil rotates in a magnetic field.

How else can a generator effect occur?

.....

.....

(1 mark)

5

END OF QUESTIONS

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Version 1.0: 21.07

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Physics 4451

PHY3H Unit 3 Physics

Mark Scheme

2009 examination – June series

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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 meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting 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 candidates' 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 to download from the AQA Website: www.aqa.org.uk

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Dr Michael Cresswell Director General

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 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 lines 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.

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

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

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

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, 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, as shown in the column 'answers', 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;

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.

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PHY3H

Question 1

question	answers	extra information	mark
1(a)(i)	secondary(coil) / output (coil)	do **not** accept just coil	1
1(a)(ii)	core (laminated soft) iron	do **not** accept for either mark it is made out of iron ore allow **1** mark for 'it is made out of iron core'	1 1
1(a)(iii)	magnetic field (which is) changing / alternating	accept magnetism / magnetic force direction (of field) changes / strength (of field) varies scoring second mark is dependent on first mark	1 1
1(b)	...step-up .... step-down ...	both in the correct order	1
1(c)	Do not build new houses .... Build new power lines away	 deduct **1** mark for any other(s) to a minimum total of (0)	1 1
Total			**8**

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PHY3H

Question 2

question	answers	extra information	mark
2(a)	C → B (1st two boxes) D → A (end two boxes)	allow **1** mark for either linkage in any position	1 1
2(b)	any **two** from: • more powerful / stronger magnet • smaller gap between coil and magnet • coil with more turns / longer coil • coil with bigger area	 do **not** accept just bigger magnet accept more coils do **not** accept just bigger coil do **not** accept just more wire do **not** accept shake faster do **not** accept shake for longer	2
2(c)(i)	the longer the torch is shaken, the longer the light lasts	accept the converse accept it is a (strong) positive (non-linear) relationship do **not** accept '.... are (directly) proportional ....'	1

Question 2 is continued on the next page . . .

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PHY3H

Question 2

question	answers	extra information	mark
2(c) (ii)	any **two** from: • if this investigation is repeated the result would not be the same • rate / amplitude / angle of shaking could vary • personal judgement when the LED / light has 'gone out' • results / data / measurements have not been repeated / averaged		2
Total			**7**

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PHY3H

Question 3

question	answers	extra information	mark
3(a)	the <u>normal</u>		1
3(b)	v		1
3(c)	any **one** from: • light has moved from glass to air / from air to glass • speed of light has changed • angle of incidence is less than the critical angle • change in density (of medium)	 accept light has changed medium beware of contradictions for this marking point eg light has moved from glass to air and slowed down gets zero **or** (angle) i < (angle) c **or** (angle) y is less than the critical angle eg glass is more (optically) dense than air	1

Question 3 continues on the next page . .

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PHY3H

Question 3 continued . . .

question	answers	extra information	mark
3(d)(i)	ratio of v to y does not give the same answer (in every case) **or** value of v doubles value of y does not double **or** increments for v are the same but increments for y are not the same	allow for **1** mark a calculation but no conclusion eg 30 → 60 19 → 35 (38)	2
3(d)(ii)	as (angle) v increases, angle y increases	accept as the angle of incidence increases, the angle of refraction increases **or** there is a (strong) positive(non-linear) relationship between the variables **or** ratio of sines is constant do **not** accept angle y is not directly proportional to angle v	1
3(d)(iii)	no evidence outside this range **or** when angle y is greater than the critical angle total internal reflection occurs	OWTTE	1
Total			**7**

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PHY3H

Question 4

question	answers	extra information	mark
4(a)(i)	the bigger the masses (of the dust and gases then) the bigger the force / gravity (between them)	accept the converse	1
4(a)(ii)	the greater the distance (between the dust and gases then) the smaller the force / gravity (between them)	accept the converse	1
4(b)	radiation 'pressure' and gravity / gravitational attraction these are balanced / in equilibrium **or** there is sufficient / a lot of hydrogen / fuel to last a very long time	 must be in correct context do **not** accept are equal second mark consequent on first	1 1
4(c)	any **two** from: • hydrogen runs out / is used up • nuclei larger than helium nuclei formed • (star expands to) / become(s) a red giant	 accept bigger atoms are formed however do **not** accept any specific mention of an atom with a mass greater than that of iron	2
Total			**6**

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PHY3H

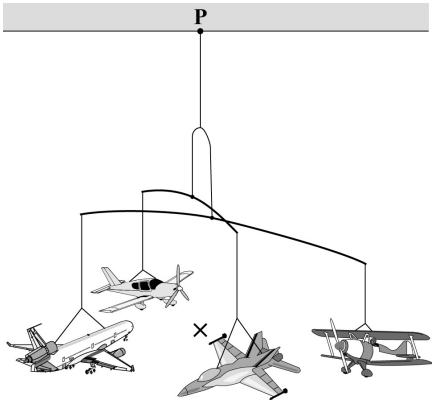
Question 5

question	answers	extra information	mark
5(a)(i)	same frequency / period / pitch / wavelength	ignore references to amplitude	1
5(a)(ii)	differences in waveform / shape / quality	accept the diagrams are not identical	1
5(b)(i)	20 000 Hz / hertz **or** 20 kHz / kilohertz	in both cases, if the **symbol** rather than the name is used, it must be correct in every detail	1
5(b)(ii)	material(s) / substance(s) (through which sound travels)		1
5(b)(iii)	is absorbed is transmitted	accept (some) sound (energy) is transformed / transferred as heat / thermal energy accept is refracted accept changes speed accept changes velocity do **not** accept is diffracted do **not** accept is diffused do **not** accept is dissipated	1 1
Total			**6**

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PHY3H

Question 6

question	answers	extra information	mark
6(a)(i)	centre of **X** directly below **P** and between the model aeroplanes	as judged by eye but between centre of propeller of top aeroplane and canopy of bottom aeroplane example  	1
6(a)(ii)	the centre of mass is (vertically) below the point of suspension / P		1
	the centre of mass is in the middle of the aeroplanes	accept the centre of mass is level with the aeroplanes	1

Question 6 continues on the next page . . .

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PHY3H

Question 6 continued . . .

question	answers	extra information	mark
6(b)	centre of mass of the worker and the ladder (and device)		1
	line of action of the weight is inside the base	accept the centre of mass is above / within / inside the base (of the ladder and device)	1
	so there will not be a (resultant) moment **or** it will (only) topple over if the line of action of the weight / the centre of mass is outside the base	accept so he / it / the ladder will not topple even if he leans over accept each point, either on the diagram or in the written explanation, but do **not** accept the point if there is any contradiction between them	1
Total			**6**

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PHY3H

Question 7

question	answers	extra information	mark
7(a)	any **two** from: • to (electrically) connect • stationary and moving parts • without tangling the wires	 accept to complete the circuit accept to allow a current / charge to flow	2
7(b)	current (induced) is reversed / changes in direction / alternates every half turn	accept (induced) p.d. <u>across</u> the coil do **not** accept p.d. <u>in</u> the coil	1 1
7(c)	by rotating / moving a magnetic field / magnet relative to a coil	accept by doing the converse / opposite	1
Total			**5**

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Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

For Examiner's Use

General Certificate of Secondary Education
January 2009

PHYSICS
Unit Physics P3

PHY3H

H

Higher Tier

Monday 19 January 2009 9.00 am to 9.45 am

For this paper you must have:
- a ruler.

You may use a calculator.

Time allowed: 45 minutes

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

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

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

For Examiner's Use			
Question	Mark	Question	Mark
1		3	
2		4	
		5	
		6	
		7	
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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Areas outside the box will not be scanned for marking

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

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

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

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

20	**2000**	**20 000**	**200 000**

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

(1 mark)

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

What does the symbol kHz stand for?

.....

(1 mark)

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

.....

(1 mark)

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

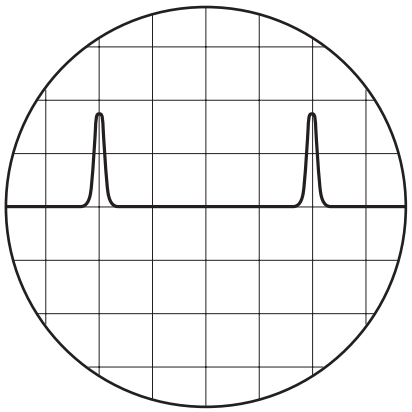
.....

(1 mark)

Areas outside the box will not be scanned for marking

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

The diagram shows centimetre squares on an oscilloscope screen.
Each horizontal division represents 2 microseconds.



Calculate the time, in microseconds, between one peak of one ultrasound pulse and the peak of the next.

.....

Time = ... microseconds
(1 mark)

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

What can be calculated from this time interval?

.....

.....
(2 marks)

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

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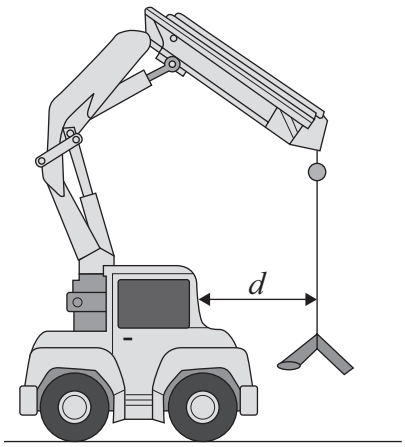
.....
(2 marks)

9

Turn over ▶

Areas outside the box will not be scanned for marking

2 The diagram shows a small mobile crane. It is used on a building site.



The distance, *d*, is measured to the front of the cab.

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

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

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

.....

.....

.....

(2 marks)

Areas outside the box will not be scanned for marking

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

Is the driver correct?

Explain your answer.

.....

.....

.....

.....

(2 marks)

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

.....

.....

(1 mark)

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

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

average results from an opinion poll of mobile crane drivers ☐

copied from a handbook for a similar crane ☐

results of experiments on a model mobile crane ☐

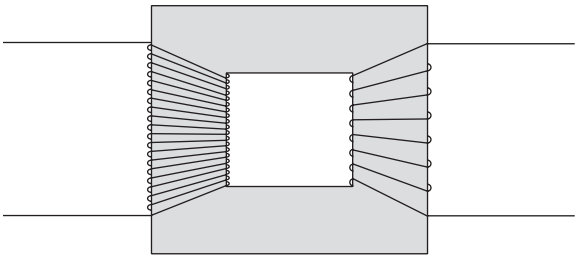
results of experiments on this mobile crane ☐

(1 mark)

6

Areas outside the box will not be scanned for marking

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



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

.....

.....

(1 mark)

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

.....

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.....

.....

(4 marks)

Areas outside the box will not be scanned for marking

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

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

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

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

Show clearly how you work out your answer.

.....

.....

Number of turns = ...

(2 marks)

7

Turn over for the next question

Areas outside the box will not be scanned for marking

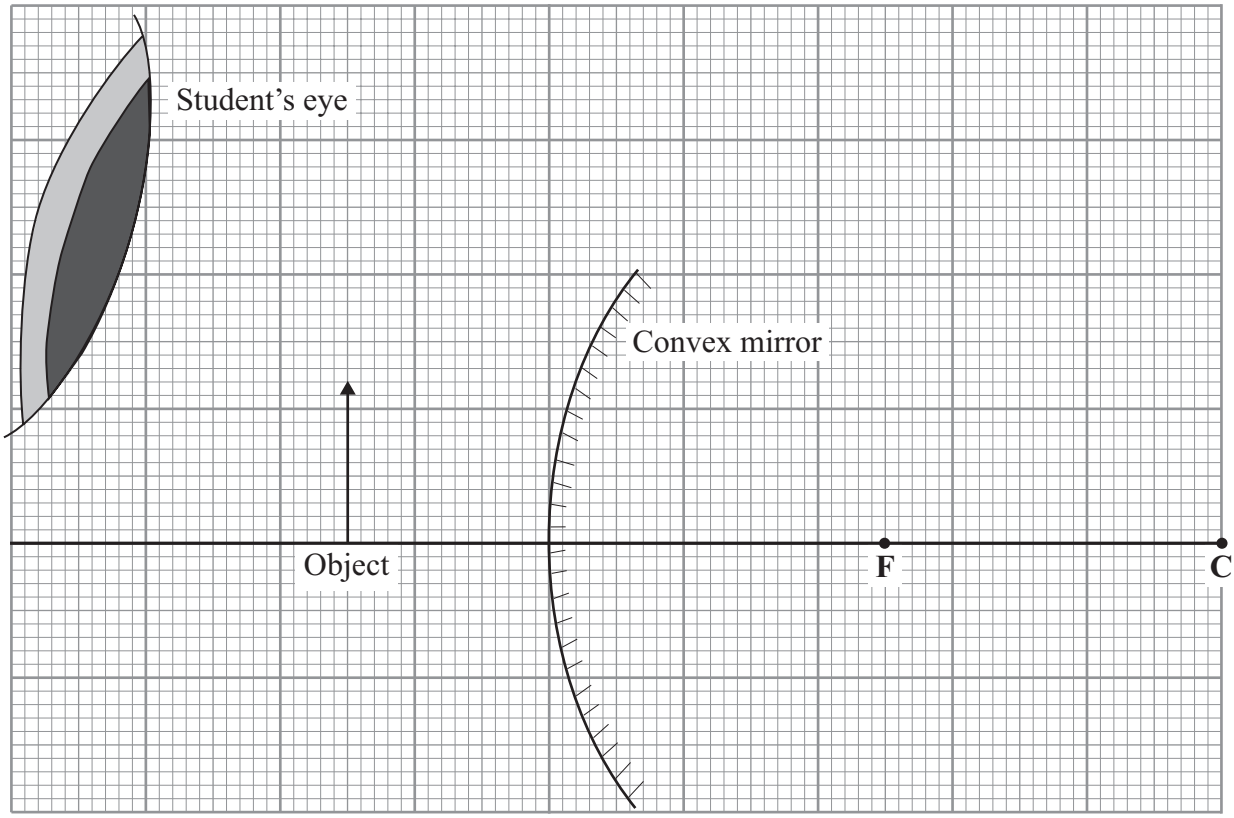
4 A student investigates the formation of images by a convex mirror.

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

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

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

Mark the direction of the rays at each stage.



(4 marks)

4 (b) The image is a virtual image.

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

.....

.....

(1 mark)

5

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Areas outside the box will not be scanned for marking

5 The table gives data on the Solar System.

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

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

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

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

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

.....

.....

.....

.....

(2 marks)

Areas outside the box will not be scanned for marking

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

.....

.....

.....

.....

(2 marks)

5 (b) The student knows the following:

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

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

.....

.....

.....

.....

(2 marks)

6

Turn over for the next question

Areas outside the box will not be scanned for marking

6 This page is from a science magazine.

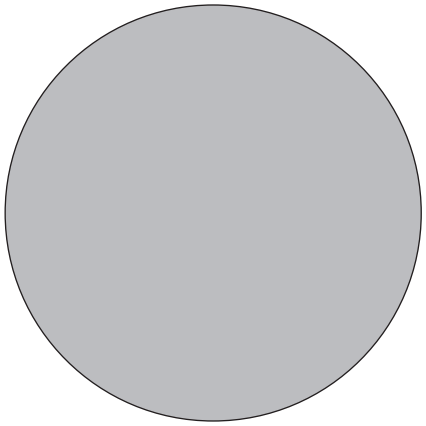
The Red Planet

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

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

Deimos

Phobos



Not to scale

Areas outside the box will not be scanned for marking

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

.....

.....

.....

.....

(2 marks)

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

Is the force increasing or decreasing?

.....

Explain your answer.

.....

.....

.....

(2 marks)

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

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

.....

.....

.....

.....

(2 marks)

6

Turn over for the next question

Areas outside the box will not be scanned for marking

7 Read this statement from a website.

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

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

.....

.....

.....

.....

(2 marks)

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

.....

.....

.....

.....

(2 marks)

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

.....

.....

.....

.....

(2 marks)

6

END OF QUESTIONS

There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED

There are no questions printed on this page

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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Physics 4451

PHY3H Unit Physics 3

Mark Scheme

2009 examination – January series

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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 meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

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PHY3H

Question 1

question	answers	extra information	mark
1(a)	20 000	accept any unambiguous indication	1
1(b)	kilohertz	credit misspellings credit '1000 hertz' or '1000 Hz' accept 1000 oscillations/beats/waves per second	1
1(c)(i)	cleaning (e.g. something delicate such as a watch)	**or** quality control/flaw detection credit any appropriate extra Specification response e.g. sonar	1
1(c)(ii)	pre-natal (scanning)	do **not** credit just 'scanning'/medical scanning credit any appropriate extra Specification response e.g. destruction of (kidney) stones or cleaning teeth	1
1(d)	8 (μs)		1
1(e)	distance (1) between the boundary and the detector (1)	 accept 'between the boundary and the source' accept any correct use of speed = distance/time	2

Question 1 continues on the next page

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PHY3H

Question 1 continued

question	answers	extra information	mark
1(f)	examples publish/tell doctors/the public (1) ... their evidence/results/ research/data (1) carry out more research/ tests (1) ... to make sure/check reliability (1)	allow a wide variety of appropriate responses valid point (1) appropriate example/ qualification/expansion/etc. (1) allow just 'stop using them/ultrasonic waves' (1) allow using them (only) for industrial purposes (1)	2
Total			**9**

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PHY3H

Question 2

question	answers	extra information	mark
2(a)	any **two** from: • inversely proportional • as the load gets bigger the (maximum safe) distance gets less • load × distance = 60 (kNm)	allow 'as the mass increases the distance decreases' accept an unspecified response e.g. 'big load at a short distance' for (1)	2
2(b)	yes, because 30 × 2 = 60 (2)	accept for (1) a correct but insufficiently explained response e.g. 'yes because it's safe' accept for (2) a correct response which is sufficiently explained e.g. 'yes, because 60 (kNm) at 1 metre is safe and 30 (kNm) is half the load at twice the distance do **not** accept 'no' and do not accept just 'yes' do **not** accept 'yes, because 30 is between 24 a and 2 is between 2.5 and 1.5' do **not** accept 'the carne/ cable may break' or other dangers	2

Question 2 continues on the next page

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PHY3H

Question 2 continued

2(c)	the crane may/will topple over/fall over/forward		1
2(d)	results of experiments on this mobile crane	accept any unambiguous indication	1
Total			**6**

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PHY3H

Question 3

question	answers	extra information	mark
3(a)(i)	(quickly) becomes magnetised	**or** (quickly) loses its magnetism **or** 'it's *(a)* magnetic *(*material*)*' any reference to conduction of electricity/heat nullifies the mark	1
3(a)(ii)	any **four** from: • insulation prevents electricity/current flowing through the iron/core • <u>alternating</u> current/a.c. in the primary (coil) • produces a <u>changing</u> magnetic field (in the iron/core) • (and hence magnetic) field in the secondary (coil) • induces/generates/ produces an <u>alternating</u> potential difference/p.d./ voltage across the secondary (coil) • (and hence) <u>alternating</u> current/a.c. in the secondary (coil)	**or** 'insulation so electricity/ current only flows in the wires/turns/coils'	4

Question 3 continues on the next page

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PHY3H

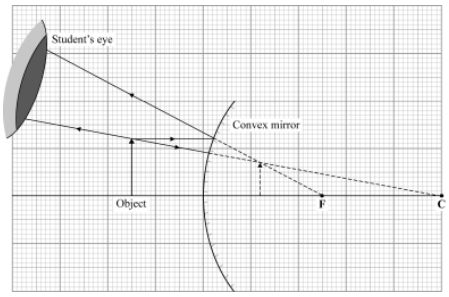
Question 3 continued

question	answers	extra information	mark
3(b)	80 (turns)	**or** credit (1) for any equation which if correctly evaluated would give 80 example $\frac{230}{5.75} = \frac{3200}{\text{number of turns}}$	2
Total			**7**

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PHY3H

Question 4

question	answers	extra information	mark
4(a)	ray from the top of the object in a straight line to **C** (1) ray from the top of the object and parallel to the principal axis reflected from the mirror as if from **F** (1) where these lines intersect vertically to the axis (to form the image) (1) direction of four <u>real</u> rays correctly shown (1)	example  note this mark depends on the first two marks being correct two from the object towards the mirror two towards the student's eye note the rays only need to go towards the eye any arrows shown on 'rays' behind the mirror invalidate this mark	4
4(b)	image is formed by the intersection of virtual/ imaginary rays	**or** the construction lines only show where the image appears to be/where light seems to come from **or** the image is behind the mirror **or** (real) rays do not pass through the image **or** (real) rays do not cross ignore reference to a 'screen'	1
Total			**5**

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PHY3H

Question 5

question	answers	extra information	mark
5(a)(i)	Uranus is twice the distance from the Sun as Saturn (1) (but) 6.8 is not half of 9.6 (1)	**or** 'Saturn is half the distance from the Sun as Uranus' **or** '(but) 9.6 is not twice 6.8' **or** 'the products are not the same'	2
5(a)(ii)	the greater the (average) distance from the Sun the less the (average orbital) speed (of the planet) (2)	**or** the converse **or** should have concluded that distance is inversely proportional to the square of the orbital speed allow a correct but non comparative statement e.g. 'a far away planet moves slowly', for (1)	2
5(b)	<u>average</u> distance/speed given (1) (because) the distance/speed is not constant/will vary (slightly)(because the orbit is an ellipse not a circle) (1)		2
Total			**6**

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PHY3H

Question 6

question	answers	extra information	mark
6(a) **E**	(from present/recent) data/evidence/observations of (the rate of change in) Phobos'/ the moon's orbit (1) (and) continued/extended/ extrapolated (the pattern/trend for the next 100 million years) (1)	or appropriate example of data (1) and its correct use (1) example (present) distance from Phobos to Mars (1) ÷ (average) rate of approach (1)	2
6(b) **E**	(it is) increasing (1) Phobos/the moon will be nearer (to Mars) (1)	 or the radius/circumference/ diameter of the orbit of Phobos/ the moon will decrease/be less only credit 2nd mark if the first mark is correct	2
6(c) **E**	it will increase/be more (1) (because) Phobos/the moon will get/be closer to Mars/ the planet (1)	 only credit 2nd mark if the first mark is correct note part(s) of this response may be included as the answer to part (b) read both before marks are awarded	2
Total			**6**

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PHY3H

Question 7

question	answers	extra information	mark
7(a)	fusion (1) of hydrogen/H (atoms)(1)	do **not** credit any response which looks like 'fission' **or** the 'word' 'fussion' credit only if a nuclear reaction	2
7(b)	fusion of other/lighter atoms/elements (1) during super nova/explosion of star(s) (1)	reference to big bang nullifies both marks	2
7(c)	explosion of star(s)/super nova (1) at the end of the 'life' of star(s) / when they 'die' (1)	reference to big bang nullifies both marks reference to the star running out of energy/material nullifies both marks	2
Total			**6**

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