AQA GCSE PHYSICS (4403)

PHYSICS



EXAM QUESTION PACK

UNIT P1 HIGHER TIER PH1HP PAPERS

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Surname _____

Forename(s) _____

Candidate signature _____

GCSE
SCIENCE A
PHYSICS

H

Higher Tier Unit Physics P1

Wednesday 25 May 2016 Afternoon Time allowed: 1 hour

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

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

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

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

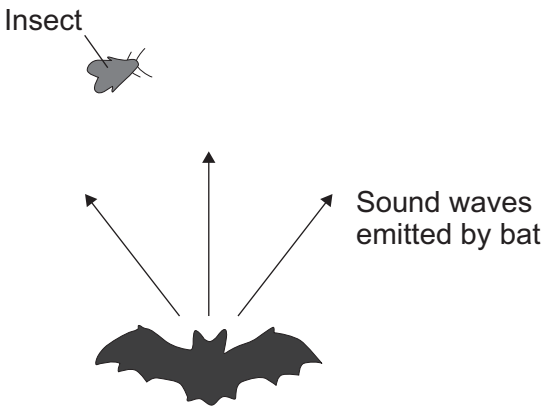
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Answer **all** questions in the spaces provided.

1 Bats use the reflection of high pitched sound waves to determine the position of objects. **Figure 1** shows a bat and an insect flying in front of the bat.

Figure 1



1 (a) What determines the pitch of a sound wave?

[1 mark]

Tick (✓) **one** box.

	Tick (✓)
amplitude	
frequency	
speed	

1 (b) State the name given to reflected sound waves.

[1 mark]

_____

Do not write outside the box

1 (c) The bat emits sound waves with a range of wavelengths.

Some of the sound waves will be diffracted by the insect.

Complete the following sentences to explain why.

[2 marks]

Diffraction is caused by the sound waves _____ as they pass the insect.

The most diffraction happens when the wavelength of the sound wave is

_____ the size of the insect.

1 (d) The bat emits a sound wave with a frequency of 25.0 kHz and a wavelength of 0.0136 metres.

Calculate the speed of this sound wave.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

_____

_____

_____

Speed = _____ m/s

1 (e) Sound waves are longitudinal. Describe a longitudinal sound wave.

[2 marks]

_____

_____

_____

_____

8

Do not write outside the box

2 A small community of people live in an area in the mountains.
The houses are not connected to the National Grid.

The people plan to buy an electricity generating system that uses either the wind or the flowing water in a nearby river.

Figure 2 shows where these people live.

Figure 2



2 (a) It would not be economical to connect the houses to the National Grid.
Give **one** reason why.

[1 mark]

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

Information about the two electricity generation systems is given in **Figure 3**.

Figure 3

The wind turbine costs £50 000 to buy and install. The hydroelectric generator costs £20 000 to buy and install. The average power output from the wind turbine is 10 kW. The hydroelectric generator will produce a constant power output of 8 kW.

Do not write outside the box

Compare the advantages and disadvantages of the two methods of generating electricity.

Use your knowledge of energy sources as well as information from **Figure 3**.

[6 marks]

Extra space

7

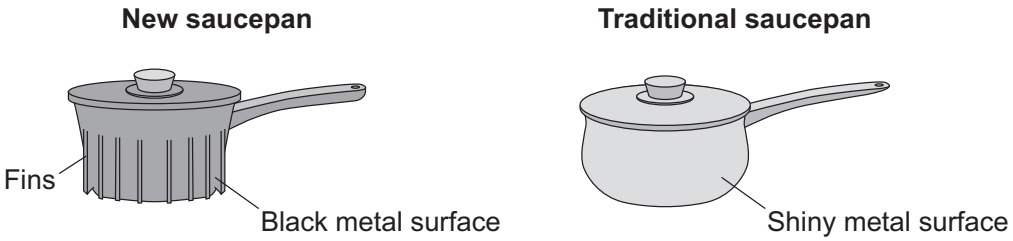
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3 (a) Heating food in a saucepan over a gas flame is inefficient.
Suggest why.

[2 marks]

3 (b) A new saucepan has been designed that heats up food much faster than a traditional saucepan. **Figure 4** shows the two saucepans.

Figure 4



Describe how the features of the new saucepan cause the food to heat up faster than when the food is heated in the traditional saucepan.

[2 marks]

Fins

Black metal surface

3 (c) State the relationship between the temperature of the saucepan and the rate at which the saucepan emits infrared radiation.

[1 mark]

5

Do not write outside the box

4 Infrared and microwaves are two types of electromagnetic radiation.

4 (a) (i) State **one** example of the use of each type of radiation for communication.

[2 marks]

Infrared: _____

Microwaves: _____

4 (a) (ii) Some of the properties of infrared and microwaves are the same.

State **two** of these properties.

[2 marks]

1 _____

_____

2 _____

_____

4 (b) In 1964, physicists discovered microwave radiation that filled the universe.

4 (b) (i) Name this type of radiation.

[1 mark]

_____

4 (b) (ii) State the importance of this discovery made by the physicists.

[1 mark]

_____

_____

6

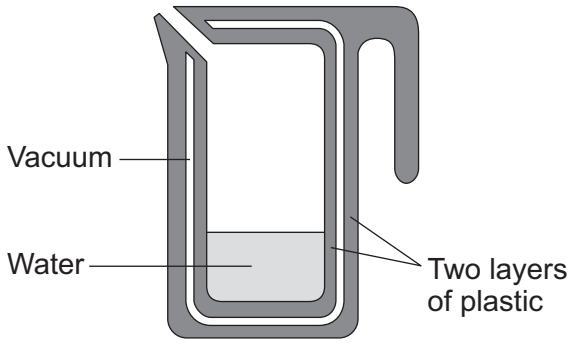
Turn over for the next question

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5 A new design for a kettle is made from two layers of plastic separated by a vacuum. After the water in the kettle has boiled, the water stays hot for at least 2 hours.

The new kettle is shown in **Figure 5**.

Figure 5



5 (a) Explain why the vacuum reduces energy transfer to the surroundings.

[2 marks]

Do not write outside the box

5 (b) The energy transferred from the water in the kettle to the surroundings in 2 hours is 46 200 J.

The mass of water in the kettle is 0.50 kg.

The specific heat capacity of water is 4200 J/kg °C.

The initial temperature of the water is 100 °C.

5 (b) (i) Calculate the temperature of the water in the kettle after 2 hours.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Temperature after 2 hours = _____ °C

5 (b) (ii) Calculate the average power output from the water in the kettle to the surroundings in 2 hours.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

Average power output = _____ W

7

Turn over for the next question

Do not write outside the box

6 All European Union countries are expected to generate 20% of their electricity using renewable energy sources by 2020.

The estimated cost of generating electricity in the year 2020 using different energy sources is shown in **Table 1**.

Table 1

Energy source	Estimated cost (in the year 2020) in pence per kWh
Nuclear	7.8
Solar	25.3
Tidal	18.8
Wind	10.0

France generated 542 billion kWh of electricity using nuclear power stations in 2011. France used 478 billion kWh of electricity and sold the rest of the electricity to other countries in 2011.

6 (a) France may continue generating large amounts of electricity using nuclear power stations instead of using renewable energy resources.

Suggest **two** reasons why.

[2 marks]

1 _____

_____

2 _____

_____

Do not write outside the box

6 (b) Give **two** disadvantages of generating electricity using nuclear power stations.

[2 marks]

1 _____

_____

2 _____

_____

6 (c) A panel of solar cells has an efficiency of 0.15.

The total power input to the panel of solar cells is 3.2 kW.

Calculate the useful power output of this panel of solar cells in kW.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

_____

_____

_____

_____

Useful power output = _____ kW

Question 6 continues on the next page

Do not write outside the box

6 (d) **Table 2** shows the manufacturing cost and efficiency of different types of panels of solar cells.

Table 2

Type of Solar Panel	Cost to manufacture a 1 m^2 solar panel in £	Efficiency in %
A	40.00	20
B	22.50	15
C	5.00	10

Some scientists think that having a low manufacturing cost is more important than improving the efficiency of solar cells.

Use information from **Table 2** to suggest why.

[2 marks]

8

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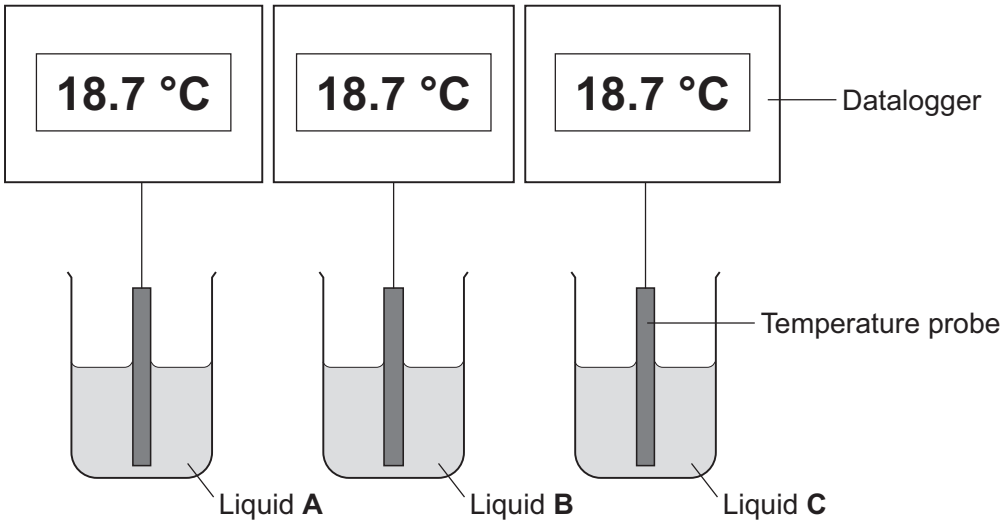
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ANSWER IN THE SPACES PROVIDED

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7 A student investigated the cooling effect of evaporation.
She used the equipment in **Figure 6** to measure how the temperature of three different liquids changed as the liquids evaporated.

Figure 6



7 (a) The temperature and volume of each liquid was the same at the start of the investigation.

State **one** further control variable in this investigation.

[1 mark]

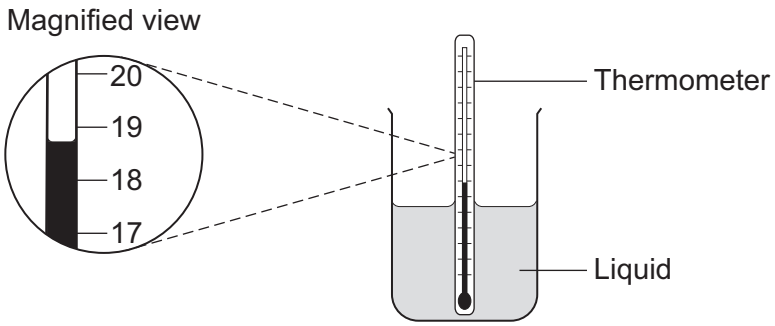
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7 (b) Give **two** advantages of using dataloggers and temperature probes compared to using the thermometer shown in **Figure 7**.

Figure 7



[2 marks]

1 _____

_____

2 _____

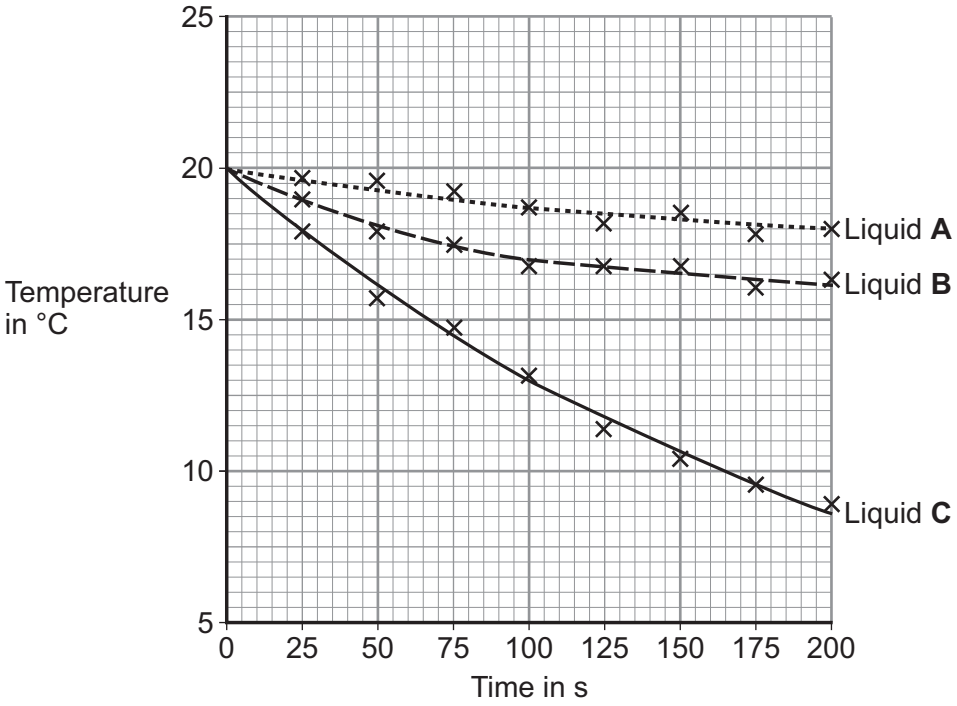
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Question 7 continues on the next page

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7 (c) The student's results are shown in **Figure 8**.

Figure 8



7 (c) (i) Calculate the average rate of temperature decrease of liquid **C** between 0 and 100 seconds.

[2 marks]

Average rate of temperature decrease = _____ °C / s

7 (c) (ii) Give **one** conclusion that can be made about the rate of temperature decrease of **all three** liquids from the results in **Figure 8**.

[1 mark]

Do not write outside the box

7 (c) (iii) Which liquid had the lowest rate of evaporation? Give a reason for your answer.

[1 mark]

Liquid _____

Reason _____

_____

7 (c) (iv) A second student did the same investigation but using a smaller volume of liquid than the first student.

All other variables were kept the same.

What effect would this have on the results of the second student's investigation?

[1 mark]

_____

_____

7 (d) Explain how the evaporation of a liquid causes the temperature of the remaining liquid to decrease.

[3 marks]

_____

_____

_____

_____

_____

_____

_____

_____

11

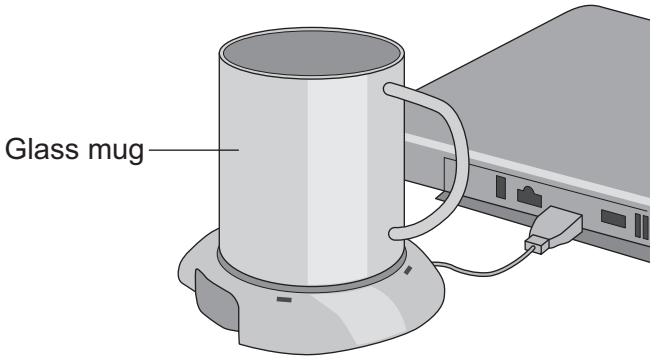
Turn over for the next question

Do not write outside the box

8 A heater uses energy from a laptop computer to keep a mug of coffee hot.

Figure 9 shows the heater connected to a laptop computer.

Figure 9



8 (a) Give **two** factors, other than the material of the mug, that would affect the rate of energy transfer to the coffee.

[2 marks]

1 _____

2 _____

8 (b) Energy is conducted slowly through the base of the glass mug.

Explain how energy is conducted through the base of the glass mug.

[2 marks]

_____

_____

_____

_____

Do not write outside the box

8 (c) Energy is transferred to the coffee at the bottom of the mug.

Explain how a convection current is set up in the coffee.

[4 marks]

8

END OF QUESTIONS

There are no questions printed on this page

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GCSE

Science A / Physics

PH1HP

Mark scheme

4405/4403
June 2016

Version 1.0: Final Mark Scheme

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

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

Further copies of this mark scheme are available from aqa.org.uk

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Mark Scheme

Information to Examiners

1. General

The mark scheme for each question shows:

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

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

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

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

2. Emboldening

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

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

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

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

3. Marking points

3.1 Marking of lists

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

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

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

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

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

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

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

3.2 Use of chemical symbols / formulae

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

3.3 Marking procedure for calculations

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

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

3.4 Interpretation of 'it'

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

3.5 Errors carried forward

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

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

3.6 Phonetic spelling

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

3.7 Brackets

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

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3.8 Accept / allow

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

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

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

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

4. Quality of Communication and levels marking

In Question **2(b)** students are required to produce extended written material in English, and will be assessed on the quality of their communication as well as the standard of the scientific response.

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

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

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

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

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

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)	frequency		1	AO1 1.5.3b
1(b)	echo(es)		1	AO1 1.5.3c
1(c)	spreading (out) equal to	changing direction is insufficient moving apart is insufficient bending is insufficient accept: similar to same (order of magnitude) as slightly smaller than slightly larger than	1 1	AO1 1.5.1g
1(d)	340 (m/s)	allow **1** mark for correct substitution ie 25 000 x 0.0136 provided no subsequent step **or** allow **1** mark for a correct calculation showing an incorrect value from conversion to hertz x 0.0136 an answer of 0.34 gains **1** mark	2	AO2 1.5.1j
1(e)	(a wave where the) oscillations are parallel to the direction of energy transfer causing (areas of) compression and rarefaction	both marking points may appear as labels on a diagram accept vibrations for oscillations accept in same direction as for parallel to allow direction of wave (motion) for direction of energy transfer accept correct description in terms of particles mechanical wave is insufficient needs a medium to travel through is insufficient	1 1	AO1 1.5.1b
Total			**8**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)	any **one** from: • high cost of installing overhead power lines or underground cables or pylons • high cost as (very) long cables needed • amount of electricity required is too low	allow not enough (surplus) electricity would be generated	1	AO1 1.4.1e

Question 2 continues on the next page . . .

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(b)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.		6	3 AO1 2 AO2 1 AO3 1.4.1b

0 marks	Level 1 (1-2 marks)	Level 2 (3-4 marks)	Level 3 (5-6 marks)
No relevant information	at least **one** advantage **or one** disadvantage of either method	at least **one** advantage **and one** disadvantage is stated for **one** method **and** a different advantage **or** disadvantage is stated for the other method	clear comparison of advantages **and** disadvantages of **each** method

examples of physics points made in the response	extra information
Advantages of both methods:	
• both renewable sources of energy	
• both have no fuel (cost)	accept carbon neutral
• both have very small (allow 'no') running costs	accept no greenhouse gases
• no carbon dioxide produced	accept doesn't contribute to global warming
Advantages of wind:	
• higher average power output	produces more energy is insufficient
Advantages of hydroelectric:	
• constant / reliable power (output)	
• lower (installation) cost	
Disadvantages of wind:	
• higher (installation) cost	
• variable / unreliable power output	
• (may) kill birds / bats	
Disadvantages of hydroelectric:	
• lower power output	
• (may) kill fish or (may) damage habitats	
• more difficult to set up (within river)	
Disadvantages of both methods	
• (may be) noisy	
• visual pollution	ignore payback time unless no other relevant points made ignore time to build for both

Total			7

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)	a proportion / percentage of the energy is wasted	allow heat for energy allow some energy is wasted	1	AO2 1.2.1b 1.2.1c
	(wasted) energy is transferred to surroundings **or** energy is needed to heat pan (before food is heated)		1	
3(b)	(fins have a) large(r) surface area	accept fins increase the surface area	1	AO1 1.1.1c 1.1.1e 1.1.3c
	(black metal surface is a) good / better absorber of infrared radiation	allow 'heat' or 'energy' for infrared radiation ignore good emitter of infrared radiation not a good reflector is insufficient	1	
3(c)	the higher the temperature (of the saucepan) the greater the rate at which infrared radiation is emitted	accept converse answer allow the higher the temperature the more infrared radiation is emitted allow there is a positive correlation	1	AO2 1.1.1b
Total			**5**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)(i)	**use of infrared:** remote controls fibre optic (communications) **use of microwaves:** mobile/cell phones satellite (communications/TV) wi-fi Bluetooth	 accept mobiles accept phone signals	1 1	AO1 1.5.1k
4(a)(ii)	any **two** from • same speed **or** travel at the speed of light (in a vacuum) • transverse • transfer energy (from one place to another) • can be reflected • can be refracted • can be diffracted • can be absorbed / transmitted • can travel through a vacuum/space • can be polarised	 accept a full description of a transverse wave travels in straight lines is insufficient	2	AO1 1.5.1c 1.5.1d 1.5.1e 1.5.1g
4(b)(i)	Cosmic Microwave Background (Radiation)	accept CMBR	1	AO1 1.5.4d
4(b)(ii)	 the Big Bang (theory) predicted the existence of CMBR **or** only the Big Bang (theory) supports the existence of CMBR	allow microwave radiation for CMBR throughout allow it supports / proves the Big Bang (theory) accept CMBR disproved other theories, eg steady state	 1	AO1 1.5.4e
Total			**6**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	no particles (in a vacuum) (so) no / reduced conduction and no / reduced convection	 both energy transfer methods needed for the mark	1 1	AO1 1.1.3a
5(b)(i)	78 (°C)	allow **2** marks for correct temperature change ie 22 ˚C allow **1** mark for correct substitution ie 46 200 = 0.5 x 4200 x θ **or** $\frac{46200}{0.5\times4200}=\theta$	3	AO2 1.1.4d
5(b)(ii)	6.4 (W)	allow **2** marks for an answer that rounds to 6.4 allow **1** mark for correct substitution ie 46 200 = P x 7200 an answer of 23 000 or 23 100 or 385 gains 1 mark	2	AO2 1.3.1c
Total			**7**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)	any **two** from: • cost per kWh is lower (than all other energy resources) • infrastructure for nuclear power already exists • more reliable (than renewable energy resources)	allow it is cheaper ignore fuel cost ignore energy released per kg of nuclear fuel accept cost of setting up renewable energy resources is high accept many renewable power stations would be needed to replace one nuclear power station accept (France in 2011 already had a) surplus of nuclear energy, so less need to develop more renewable capacity for increased demand in the future accept France benefits economically from selling electricity accept (nuclear) fuel is readily available ignore destruction of habitats for renewables	2	AO1 AO2 1.4
6(b)	any **two** from: • non-renewable • high decommissioning costs • produces radioactive / nuclear waste • long start-up time • nuclear accidents have widespread implications	allow nuclear fuel is running out accept high commissioning costs allow waste has a long half-life allow for nuclear accident a named nuclear accident eg Fukushima, Chernobyl ignore visual pollution	2	AO1 1.4.1f

Question 6 continues on the next page . . .

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(c)	0.48 (kW)	allow **1** mark for correct substitution ie 0.15 = P / 3.2 an answer of 480 W gains **2** marks an answer of 48 or 480 scores **1** mark	2	AO2 1.2.1d
6(d)	the higher the efficiency, the higher the cost (per m^2 to manufacture)	accept a specific numerical example	1	AO2 AO3 1.4.1c
	more electricity could be generated for the same (manufacturing) cost using lower efficiency solar panels **or** (reducing the cost) allows more solar panels to be bought	accept a specific numerical example	1	
Total			**8**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	surface area **or** duration of experiment	accept shape of beaker size of beaker is insufficient	1	AO3 1.1.3b
7(b)	any **two** from: • takes readings automatically • takes readings more frequently • reduces / no instrument reading error • higher resolution • don't need to remove probe to take reading • more accurate	ignore easier **or** takes readings for you ignore human error allow better resolution	2	AO3 1.1.3
7(c)(i)	0.07 (°C/s)	allow **1** mark for obtaining a temperature drop of 7(ºC) allow **1** mark for an answer between 0.068 and 0.069 (°C/s)	2	AO2 1.1.3d
7(c)(ii)	rate of temperature change is greater at the start **or** rate of temperature change decreases	accept rate of evaporation is greater at the start allow rate of evaporation decreases allow temperature decreases faster at the start	1	AO3 1.1.3b

Question 7 continues on the next page . . .

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(c)(iii)	A lower temperature decrease (over 200 seconds)	reason only scores if A is chosen accept lower gradient	 1	AO3 1.1.3b
7(c)(iv)	no effect (as rate of evaporation is unchanged)	allow larger temperature change (per second as mass of liquid is lower)	1	AO3 1.1.3b
7(d)	particles with more energy leave the (surface of the) liquid (which) reduces the average (kinetic) energy (of the remaining particles)	accept particles with higher speeds allow reference to the total energy of the liquid reducing	1 1 1	AO1 1.1.3b
Total			**11**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
8(a)	any **two** factors: • surface area (of mug in contact with cup warmer) • thickness of mug • temperature of heater / coffee • power of the heater	 accept temperature difference (between heater and coffee) accept power of the laptop ignore efficiency of the heater	2	AO3 1.1.3c
8(b)	atoms (gain kinetic energy and) vibrate faster / more energy is passed on from atom to atom by collision	allow particles / molecules for atoms allow bigger / faster vibrations do not accept start to vibrate accept vibrations for energy an answer in terms of free electrons scores zero	1 1	AO1 1.1.3a
8(c)	the particles spread out (so) coffee becomes less dense (so) the heated coffee rises (and) cooler / denser coffee falls	allow fluid / liquid / water for coffee throughout answer allow particles move further apart allow (coffee) expands particles rise is insufficient particles fall is insufficient	1 1 1 1	AO1 1.1.3a
Total			**8**	

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

General Certificate of Secondary Education
Higher Tier
June 2015

Science A
Unit Physics P1

PH1HP

H

Physics
Unit Physics P1

Friday 12 June 2015 1.30 pm to 2.30 pm

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

A

Time allowed
- 1 hour

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

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

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

Do not write outside the box

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

1 **Figure 1** shows a man using a leaf blower to move leaves.

Figure 1



The leaf blower is powered by an electric motor connected to a battery.

1 (a) Energy transfers take place when the leaf blower is being used.

Complete the following sentences.

[3 marks]

The battery stores ..... energy which is transferred into electrical energy.

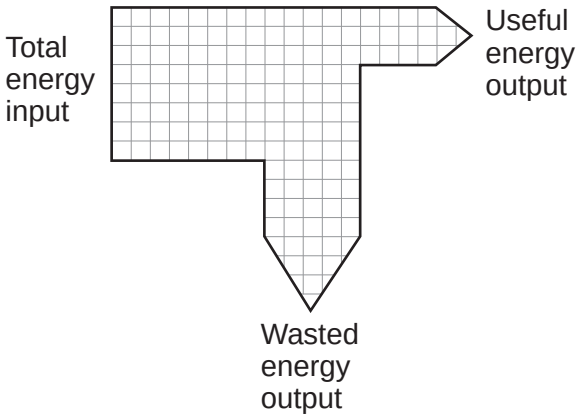
The electric motor transfers electrical energy usefully into ..... energy.

The motor wastes energy as ..... and as energy that heats the surroundings.

Do not write outside the box

1 (b) **Figure 2** shows a Sankey diagram for the leaf blower.

Figure 2



Use **Figure 2** to calculate the efficiency of the leaf blower.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Efficiency = ...

5

Turn over for the next question

Do not write outside the box

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

A householder wants to reduce her energy bills. She collected information about a number of ways of reducing energy used. The information is shown in **Table 1**.

Table 1

Ways of reducing energy used	Cost to buy and install in £	Money saved per year in £
Install an energy-efficient boiler	2 000	320
Insulate the loft	400	200
Install double-glazed windows	12 000	120
Install cavity wall insulation	415	145

Use the information in **Table 1** to compare the different ways of reducing the energy used. Your answer should include some calculations.

[6 marks]

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Extra space .....

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2 (b) Increasing the amount of insulation in a house affects the total U-value of the house.

2 (b) (i) What is meant by the term 'U-value'?

[1 mark]

.....

.....

.....

2 (b) (ii) How is the U-value affected by increasing the amount of insulation?

[1 mark]

.....

8

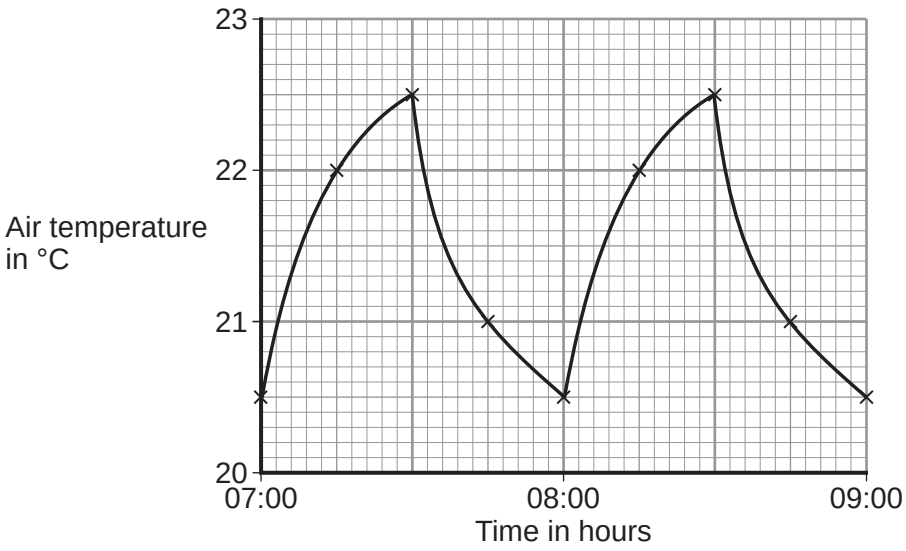
Turn over for the next question

Do not write outside the box

3 A householder monitored how the air temperature inside his house changed over a 2-hour period. The householder measured the temperature every 15 minutes.

Figure 3 shows how the temperature changed with time.

Figure 3



3 (a) (i) The householder used a digital thermometer to measure the temperature.

What would be an appropriate resolution for the digital thermometer?

[1 mark]

Draw a ring around your answer.

0.5 °C **1 °C** **5 °C**

3 (a) (ii) The householder's results are shown on a line graph in **Figure 3**.

Why would it **not** be appropriate to use the results to plot a bar chart?

[1 mark]

.....

.....

Do not write outside the box

3 (b) The householder's heating is controlled by a thermostat. The thermostat switches the heating on when the temperature decreases below a certain temperature.

3 (b) (i) At what temperature does the thermostat switch the heating on?

[1 mark]

..... °C

3 (b) (ii) Use **Figure 3** to determine the number of minutes that the householder's heating was switched on between 07:00 and 09:00.

[1 mark]

.....

.....

Time = ... minutes

Question 3 continues on the next page

Do not write outside the box

3 (c) The householder read the following extract from a newspaper article about reducing energy use in the home.

> . . . decreasing the temperature setting on your thermostat by 1 °C will reduce your heating bill by 10% . . .

On Monday, the householder set his thermostat at 20.0 °C and recorded the energy, in kWh, used to heat his house.

On Tuesday, the householder set his thermostat at 19.0 °C and recorded the energy, in kWh, used to heat his house.

Table 2 shows the results of the householder's investigation.

Table 2

Thermostat setting in °C	Energy in kWh
20.0	8.0
19.0	7.2

3 (c) (i) The outside temperature was the same on both days.

Give **one** reason why this was important.

[1 mark]

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.....

3 (c) (ii) Explain how the results shown in **Table 2** support the extract from the newspaper article.

Justify your answer with a calculation.

[2 marks]

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Do not write outside the box

3 (c) (iii) The statement in the extract is **not** valid for all situations.
Suggest why.

[2 marks]

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9

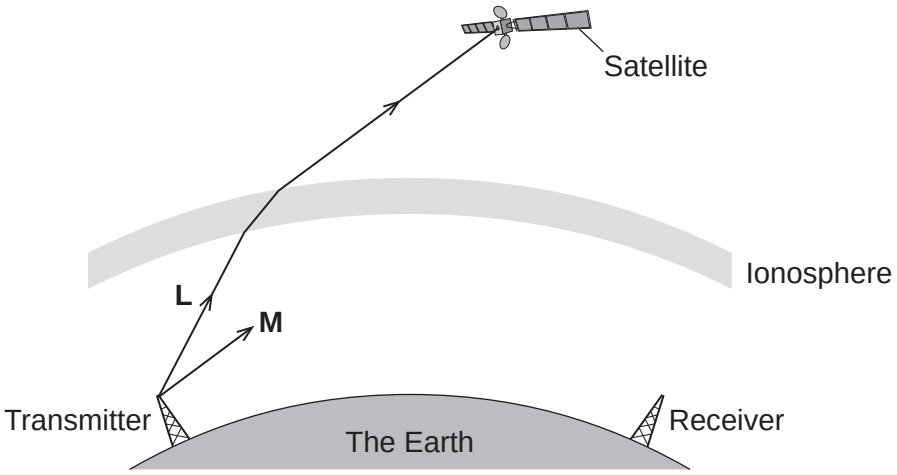
Turn over for the next question

Do not write outside the box

4 Different parts of the electromagnetic spectrum are useful for different methods of communication.

Figure 4 shows a transmitter emitting two electromagnetic waves, **L** and **M**.

Figure 4



4 (a) (i) Wave **L** is used to send a signal to a satellite.
Which part of the electromagnetic spectrum does wave **L** belong to?

[1 mark]

.....

4 (a) (ii) What name is given to the process that occurs as wave **L** passes into the ionosphere?

[1 mark]

.....

4 (b) Wave **M** is **reflected** by the ionosphere.

4 (b) (i) On **Figure 4**, draw the path of wave **M** until it reaches the receiver.

[2 marks]

4 (b) (ii) On **Figure 4**, draw a line to show the normal where wave **M** meets the ionosphere.
Label the line **N**.

[1 mark]

Do not write outside the box

4 (c) Give **two** properties of all electromagnetic waves.

[2 marks]

1 .....

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2 .....

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7

Turn over for the next question

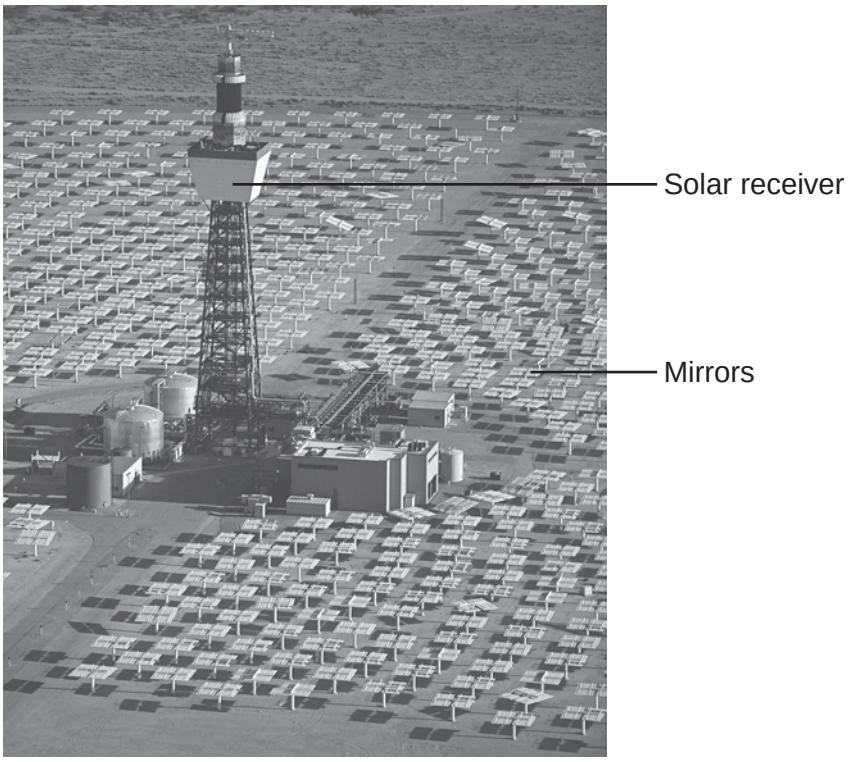
Do not write outside the box

5 **Figure 5** shows a solar thermal power station that has been built in a hot desert.

The power station uses energy from the Sun to heat water to generate electricity.

Energy from the Sun is reflected towards a solar receiver using many mirrors.

Figure 5



5 (a) (i) Which part of the electromagnetic spectrum provides most of the energy to heat the water in a solar thermal power station?

[1 mark]

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Do not write outside the box

5 (a) (ii) Describe how heated water is used to generate electricity by this solar thermal power station.
The process is the same as in a fossil fuel power station.

[3 marks]

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5 (b) A new type of solar power station, called a solar storage power station, is able to store energy from the Sun by heating molten chemical salts.
The stored energy can be used to generate electricity at night.

5 (b) (i) It is important that the molten chemical salts have a high specific heat capacity.
Suggest **one** reason why.

[1 mark]

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5 (b) (ii) The solar storage power station can store a maximum of 2 200 000 kWh of energy.
The solar storage power station can supply a town with a maximum electrical power of 140 000 kW.

Calculate for how many hours the energy stored by the solar storage power station can supply the town with electrical power.

Give your answer to 2 significant figures.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

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Time = ... hours

Question 5 continues on the next page

Turn over ▶

Do not write outside the box

5 (b) (iii) **Table 3** gives information about the place where the solar storage power station has been built.

Table 3

Season	Mean number of daylight hours	Mean power received from the Sun per square metre in kW
Spring	11.5	0.90
Summer	13.5	1.10
Autumn	12.0	0.95
Winter	10.5	0.71

The solar storage power station does not operate at the maximum possible electrical output every day of the year.

Suggest why.

[2 marks]

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5 (c) Power stations do not work at maximum possible electrical output all the time.
The 'capacity factor' of a power station is calculated using the equation:

$$\text{Capacity factor} = \frac{\text{actual electrical output per year}}{\text{maximum possible electrical output per year}}$$

Do not write outside the box

Table 4 shows capacity factors for different types of power station.

Table 4

Type of power station	Renewable energy source	Capacity factor
Coal	No	0.41
Natural gas	No	0.48
Nuclear	No	0.66
Solar thermal	Yes	0.33
Tidal	Yes	0.26
Wind turbine	Yes	0.30

5 (c) (i) Compare the capacity factors of the renewable power stations with those of the non-renewable power stations in **Table 4**.
Explain the reason for the difference between the capacity factors.

[3 marks]

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5 (c) (ii) The capacity factor of a solar storage power station is higher than for all other renewable power stations.
Suggest **one** reason why.

[1 mark]

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14

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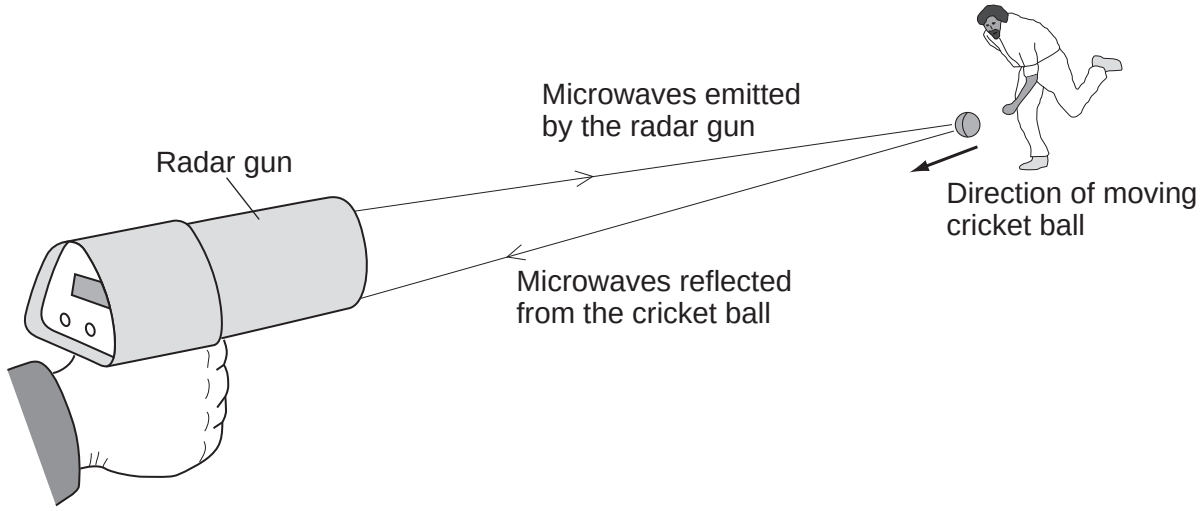
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ANSWER IN THE SPACES PROVIDED

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6 A radar gun is used to determine the speed of a cricket ball during a cricket match. The radar gun emits a beam of microwaves. The microwaves are reflected from the moving ball, as shown in **Figure 6**.

Figure 6



Comparing the microwaves emitted by the radar gun with the microwaves reflected from the cricket ball enables the speed of the ball to be determined.

6 (a) What is the name given to the effect used to determine the speed of the cricket ball?

[1 mark]

.....

6 (b) Compare the wavelength, frequency and speed of the **reflected** microwaves with the wavelength, frequency and speed of the microwaves emitted by the radar gun.

[3 marks]

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4

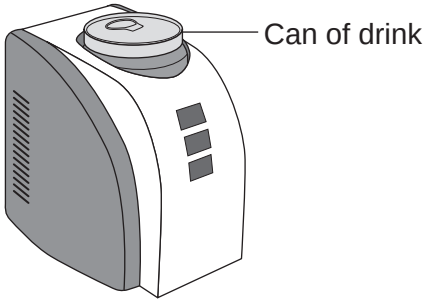
Turn over for the next question

Do not write outside the box

7 A 'can-chiller' is used to make a can of drink colder.

Figure 7 shows a can-chiller.

Figure 7



7 (a) The initial temperature of the liquid in the can was 25.0 °C.
The can-chiller decreased the temperature of the liquid to 20.0 °C.
The amount of energy transferred from the liquid was 6930 J.
The mass of liquid in the can was 0.330 kg.

Calculate the specific heat capacity of the liquid.

Give the unit.

Use the correct equation from the Physics Equations Sheet.

[4 marks]

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Specific heat capacity = ... unit .....

Do not write outside the box

7 (b) Energy is transferred through the metal walls of the can of drink by conduction. Explain how.

[4 marks]

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7 (c) The energy from the can of drink is transferred to the air around the can-chiller. A convection current is set up around the can-chiller. Explain how.

[3 marks]

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7 (d) The can-chiller has metal cooling fins that are designed to transfer energy quickly to the surroundings.

Give **two** features that would help the metal cooling fins to transfer energy quickly to the surroundings.

[2 marks]

1 .....

2 .....

13

END OF QUESTIONS

Do not write outside the box

There are no questions printed on this page

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Question 5, Figure 5: © Getty

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GCSE

Science A / Physics

PH1HP

Mark scheme

4405/4403
June 2015

Version/Stage: 1.0 Final

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

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

Further copies of this mark scheme are available from aqa.org.uk

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Mark Scheme

Information to Examiners

1. General

The mark scheme for each question shows:

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

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

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

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

2. Emboldening

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

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

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

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

3. Marking points

3.1 Marking of lists

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

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

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

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

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

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

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

3.1 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.

3.2 Marking procedure for calculations

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

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

3.3 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.

3.4 Errors carried forward

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

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

3.5 Phonetic spelling

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

3.6 Brackets

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

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3.2 Ignore / Insufficient / Do not allow

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

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

4. Quality of Communication and levels marking

In Question **2a** students are required to produce extended written material in English, and will be assessed on the quality of their communication as well as the standard of the scientific response.

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

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

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

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

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

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Question	Answers	Extra information	Mark	AO / Spec. ref.
1(a)	chemical kinetic sound	correct order only	1 1 1	AO1 P1.2.1a
1(b)	37.5% or 0.375	an answer rounded to 0.38 or 38% scores both marks an answer of 0.375 with a unit gains **1** mark an answer of 0.375% gains **1** mark an answer of 37.5 with or without a unit gains **1** mark allow **1** mark for an answer 3/8 3/8 with a unit scores 0	2	AO2 P1.2.1d
Total			**5**	

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<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th><th>ID</th></tr>
<tr><td>2 (a)</td><td colspan="2">Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 4 and apply a ‘best-fit’ approach to the marking.</td><td>6</td><td>AO2
AO3
P1.2
HSW</td><td>E</td></tr>
<tr><td>0 marks</td><td>Level 1 (1-2 marks)</td><td>Level 2 (3-4 marks)</td><td colspan="3">Level 3 (5-6 marks)</td></tr>
<tr><td>No relevant information</td><td>There is a relevant statement about an energy saving method</td><td>There is at least one clear comparison of energy saving methods and their cost effectiveness with an appropriate calculation</td><td colspan="3">There is a comparison of energy saving methods and their cost effectiveness with appropriate calculations. Comparison to include further detail.</td></tr>
<tr><td colspan="3">examples of physics points made in the response
examples of relevant statements
• energy efficient boiler saves the most (energy / money) per year
• loft insulation costs the least to install
• double-glazing costs the most to install
examples of statements that include cost effectiveness
• loft insulation is the most cost effective in the long term
• double-glazing is the least cost effective
• loft insulation has the shortest payback time
• double-glazing has the longest payback time
• payback time calculated for any method
examples of further detail
• for cost effectiveness install in the following order: loft, cavity wall, boiler, double-glazing
• for reducing energy use install in the following order: boiler, loft, cavity wall, double glazing
• don’t install double-glazing for insulation purposes
• double-glazing won’t pay for itself in your lifetime
• justified choice of best / worst method</td><td colspan="3">extra information
payback times:
energy efficient boiler: 6.25 years
loft insulation: 2 years
double glazing: 100 years
cavity wall insulation: 2.86 years</td></tr>
</table>

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Question 2 continued . . .

Question	Answers	Extra information	Mark	AO / Spec. ref.
2(b)(i)	how effective a material is as an insulator	accept 'heat' for energy accept how effective a material is at keeping energy in accept the lower the U-value the better the insulator accept the lower the U-value the lower the rate of energy transfer	1	AO1 P1.1.4a
2(b)(ii)	(the U-value) decreases		1	AO1 P1.1.4b
Total			**8**	

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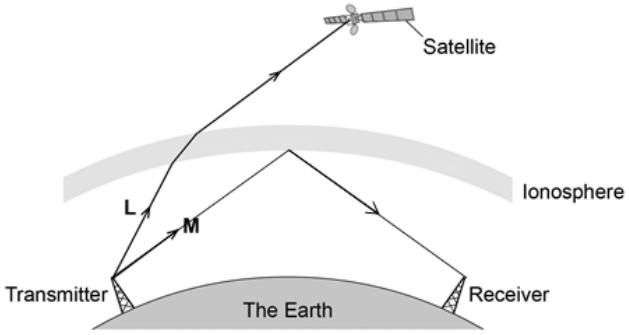
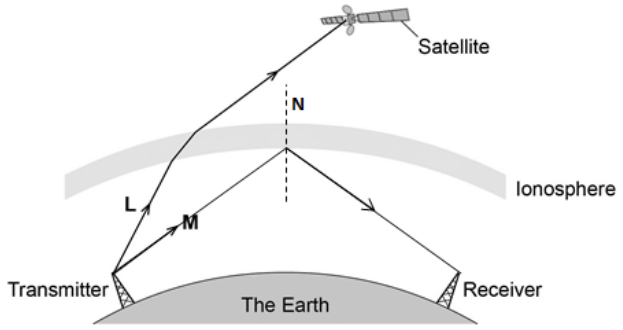
Question	Answers	Extra information	Mark	AO / Spec. ref.
3(a)(i)	0.5 °C		1	AO3 P1.1
3(a)(ii)	data is continuous **or** both variables are continuous **or** independent variable is continuous **or** time is continuous	accept results / measurements for data accept data is not categoric one variable is continuous is insufficient air temperature is continuous is insufficient	1	AO3 P1.1
3(b)(i)	20.5 (°C)		1	AO2 P1.1
3(b)(ii)	60 (minutes)	accept 1 hour	1	AO2 P1.1
3(c)(i)	so a comparison can be made **or** outside temperature is a control variable	accept: (outside) temperature would affect energy required (to maintain temperature of the house) **or** (outside) temperature would affect internal temperature (of the house) **or** heat loss will be faster on a cold day outside temperature will affect the results is insufficient fair test is insufficient	1	AO3 P1.1

Question 3 continues on the next page . . .

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Question	Answers	Extra information	Mark	AO / Spec. ref.
3(c)(ii)	the cost is equal to the number of kWh x the cost per kWh calculation 0.8 / 8.0 = 0.1 or 10%	accept (heating) bill depends on (number of) kWh used accept energy for kWh allow 7.2 / 8.0 = 0.9 or 90%	1 1	AO3 AO2 P1.1
3(c)(iii)	heating is on for more / less time (than anticipated) because some days it is cooler / warmer (than anticipated)	 accept other sensible suggestions an answer giving two sensible situations gains **2** marks possible examples: • some houses have different amounts of insulation • there are different styles of house temperature (inside / outside) is always changing is insufficient	1 1	AO3 P1.1
Total			**9**	

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Question	Answers	Extra information	Mark	AO / Spec. ref.
4(a)(i)	microwave		1	AO1 P1.5.1k
4(a)(ii)	refraction		1	AO1 P1.5.1g
4(b)(i)	wave M continues as a straight line to the ionosphere and shown reflected correctly reflected wave shown as a straight line reaching the top of the receiver  	accept reflection at or within the ionosphere if more than 2 rays shown 1 mark maximum ignore arrows	1 1	AO2 P1.5.2b
4(b)(ii)	normal drawn at point where their **M** meets the ionosphere  		1	AO1 P1.5.2a

Question 4 continues on the next page. . .

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Question 4 continued…

Question	Answers	Extra information	Mark	AO / Spec. ref.
4(c)	any **two** from: • transverse • same speed (through air) • can be reflected • can be refracted • can be diffracted • can be absorbed • transfer energy • can travel through a vacuum • can be polarised • show interference	accept speed of light **or** 3 x 10^8 m/s an answer travel at the same speed though a vacuum scores **2** marks travel in straight lines is insufficient	2	AO1 P1.5.1a,bc, d,g
Total			**7**	

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Question	Answers	Extra information	Mark	AO / Spec. ref.
5(a)(i)	infrared (radiation)	accept IR (radiation)	1	AO1 P1.1.1b
5(a)(ii)	(heated) water turns to steam	ignore reference to fossil fuels do **not** accept water evaporates to steam	1	AO1 P1.4.1a
	steam turns a turbine		1	
	turbine turns a generator	accept turbine connected to a generator	1	
5(b)(i)	(so the molten salts) can store large amounts of energy	accept there is a small temperature change for a large energy transfer accept heat for energy	1	AO2 P1.1.4d
5(b)(ii)	16 (hours)	an answer that rounds to 16 gains **2** marks eg 15.71 allow **1** mark for a correct substitution ie 2 200 000 = 140 000 x t	3	AO2 AO1 P1.3.1c
5(b)(iii)	the number of daylight hours varies	less sunlight is insufficient	1	AO2 AO3 P1.4
	the (mean) power (received from the Sun per square metre) varies	accept an answer in terms of maximum possible electrical output only possible during Summer for **1** mark	1	

Question 5 continues on the next page . . .

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Question 5 continued . . .

Question	Answers	Extra information	Mark	AO / Spec. ref.
5(c)(i)	non-renewable power stations have higher Capacity Factors than renewable power stations		1	AO1 AO3 P1.4
	fuel (for non-renewable power stations) is always available	reference to non-renewable power stations operating all the time is insufficient non-renewable energy sources are reliable is insufficient	1	
	(most) renewable energy sources are unpredictable / unreliable	accept (most) renewable energy sources depend on the weather	1	
5(c)(ii)	the (proportion of) time that solar storage power stations can generate electricity is greater (than for other renewable energy sources)		1	AO1 P1.4
Total			**14**	

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Question	Answers	Extra information	Mark	AO/Spec ref.
6(a)	Doppler (effect)		1	AO1 P1.5.4a
6(b)	(reflected microwaves) wavelength decreased (reflected microwaves) frequency increased (reflected microwaves) have same speed		1 1 1	AO1 P1.5.4a P1.5.1d
Total			**4**	

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Question	Answers	Extra information	Mark	AO / Spec. ref.
7(a)	4200	allow **2** marks for correct substitution ie 6930 = 0.330 x c x 5.0 answers of 1050 **or** 840 **or** correctly calculated answer from correct substitution of incorrect temperature change **or** identification of temperature change ie 5 ˚C gain **1** mark	3	AO2 AO1 P1.1.4d
	J/kg˚C	accept J/kg K	1	
7(b)	(in a metal) free electrons	to gain full credit the answer must be in terms of free electrons	1	AO1 P1.1.3a
	gain kinetic energy	accept move faster	1	
	(free electrons) transfer energy to other electrons / ions / atoms	do **not** accept particles	1	
	by collision		1	
		allow a maximum of **2** marks for answers in terms of atoms / ions / particles • gaining kinetic energy or vibrating faster / more • transferring energy by collisions		
7(c)	(air) particles spread out		1	AO1 P1.1.3a
	(which causes the) air to become less dense / expand	do **not** accept particles become less dense	1	
	(so the) warm air rises	do **not** accept heat rises particles rise is insufficient	1	
7(d)	large surface area	ignore references to type of metal or external conditions	1	AO1 P1.1.3c
	black / dark (colour)		1	
Total			**13**	

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

AQA

General Certificate of Secondary Education
Higher Tier
June 2014

Science A
Unit Physics P1

PH1HP

H

Physics
Unit Physics P1

Thursday 12 June 2014 9.00 am to 10.00 am

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

A

Time allowed
- 1 hour

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

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

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

Do not write outside the box

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

1 Electricity can be generated using various energy sources.

1 (a) Give **one** advantage and **one** disadvantage of using nuclear power stations rather than gas-fired power stations to generate electricity.

[2 marks]

Advantage .....

.....

Disadvantage .....

.....

1 (b) (i) A single wind turbine has a maximum power output of 2 000 000 W.

The wind turbine operated continuously at maximum power for 6 hours.

Calculate the energy output in kilowatt-hours of the wind turbine.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Energy output = ... kWh

1 (b) (ii) Why, on average, do wind turbines operate at maximum power output for only 30% of the time?

[1 mark]

.....

.....

1 (c) An on-shore wind farm is made up of many individual wind turbines.

They are connected to the National Grid using underground power cables.

Give **one** advantage of using underground power cables rather than overhead power cables.

[1 mark]

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6

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

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

The information in the box is about the properties of solids and gases.

Solids:
- have a fixed shape
- are difficult to compress (to squash).

Gases:
- will spread and fill the entire container
- are easy to compress (to squash).

Use your knowledge of kinetic theory to explain the information given in the box.

You should consider:
- the spacing between the particles
- the movement of individual particles
- the forces between the particles.

[6 marks]

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Extra space .....

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6

Turn over for the next question

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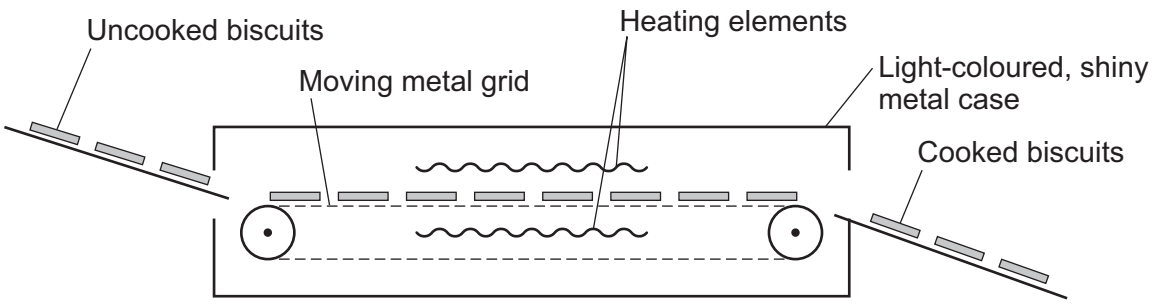
3 **Figure 1** shows one way that biscuit manufacturers cook large quantities of biscuits.

The uncooked biscuits are placed on a moving metal grid.

The biscuits pass between two hot electrical heating elements inside an oven.

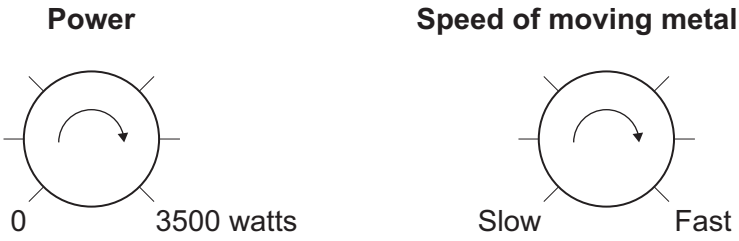
The biscuits turn brown as they cook.

Figure 1



The oven has two control knobs, as shown in **Figure 2**.

Figure 2



3 (a) Which type of electromagnetic radiation makes the biscuits turn brown?

[1 mark]

.....

3 (b) Suggest **two** ways of cooking the biscuits in this oven, to make them turn browner.

[2 marks]

1 .....

.....

2 .....

.....

Do not write outside the box

3 (c) The inside and outside surfaces of the oven are light-coloured and shiny.

Explain why.

[3 marks]

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6

Turn over for the next question

Do not write outside the box

4 A note was played on an electric keyboard.

The frequency of the note was 440 Hz.

4 (a) (i) What does a frequency of 440 Hz mean?

[1 mark]

.....

.....

4 (a) (ii) The sound waves produced by the keyboard travel at a speed of 340 m/s.

Calculate the wavelength of the note.

Use the correct equation from the Physics Equations Sheet.

Give your answer to **three** significant figures.

[3 marks]

.....

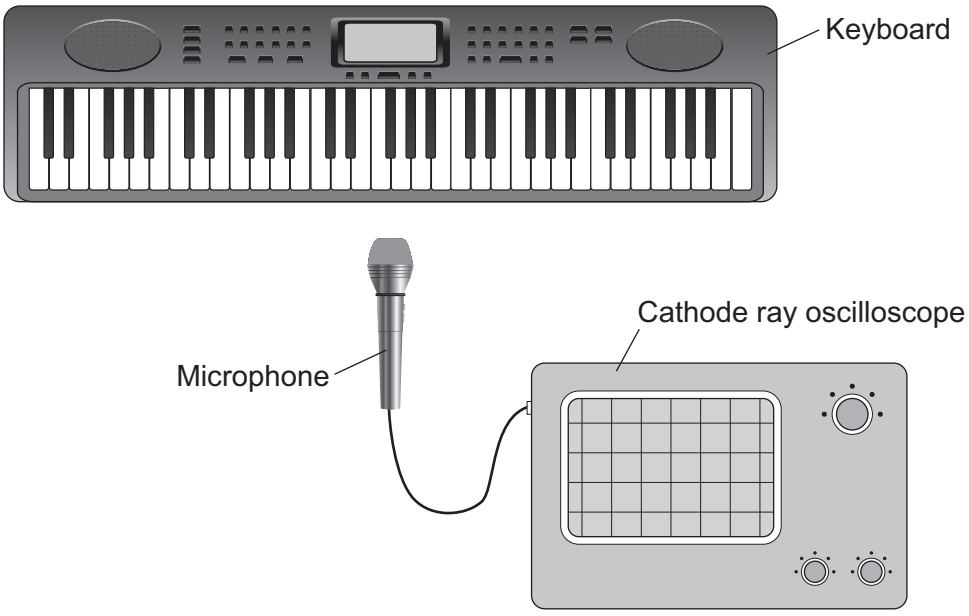
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Wavelength = ... metres

4 (b) **Figure 3** shows a microphone connected to a cathode ray oscilloscope (CRO) being used to detect the note produced by the keyboard.

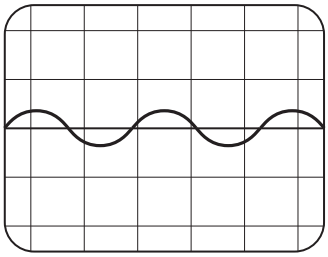
Figure 3



Do not write outside the box

Figure 4 shows the trace produced by the sound wave on the CRO.

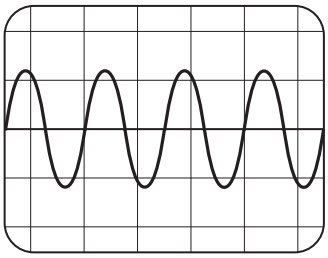
Figure 4



A second note, of different wavelength, was played on the keyboard.

Figure 5 shows the trace produced by the sound wave of the second note on the CRO.

Figure 5



The settings on the CRO were unchanged.

What **two** conclusions should be made about the **second** sound wave produced by the keyboard compared with the **first** sound wave?

Give a reason for each conclusion.

[4 marks]

Conclusion 1 .....

.....

Reason .....

.....

Conclusion 2 .....

.....

Reason .....

.....

8

Do not write outside the box

5 (a) Iceland is a country that generates nearly all of its electricity from renewable sources.

In 2013, about 80% of Iceland's electricity was generated using hydroelectric power stations (HEP).

Describe how electricity is generated in a hydroelectric power station. Include the useful energy transfers taking place.

[4 marks]

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Do not write outside the box

5 (b) The UK produces most of its electricity from fossil fuels.

Many people in the UK leave their televisions in 'stand by' mode when not in use, instead of switching them off.

It is better for the environment if people switch off their televisions, instead of leaving them in 'stand by' mode.

Explain why.

[3 marks]

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5 (c) A scientist wrote in a newspaper:

'Appliances that do not automatically switch off when they are not being used should be banned.'

Suggest why scientists alone cannot make the decision to ban these appliances.

[1 mark]

.....

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8

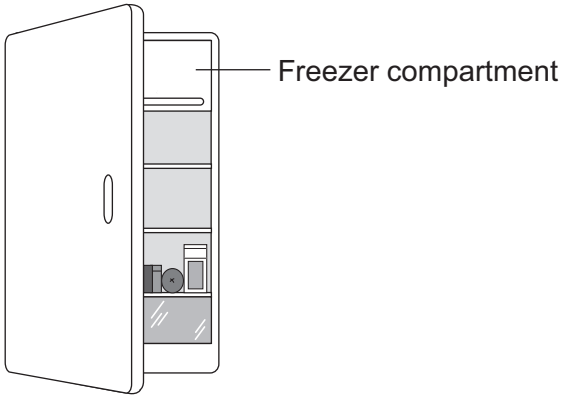
Turn over for the next question

Do not write outside the box

6 (a) **Figure 6** shows a fridge with a freezer compartment.

The temperature of the air inside the freezer compartment is –5 °C.

Figure 6



The air inside the fridge forms a convection current when the fridge door is closed.
Explain why.

[4 marks]

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Do not write outside the box

6 (b) **Table 1** shows information about four fridges.

Table 1

Fridge	Volume in litres	Energy used in one year in kWh
A	250	300
B	375	480
C	500	630
D	750	750

A householder concludes that the energy used in one year is directly proportional to the volume of the fridge.

Explain why her conclusion is **not** correct.

Use data from the table in your answer.

[2 marks]

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6 (c) New fridges are more efficient than fridges made twenty years ago.

Give **one** advantage and **one** disadvantage of replacing an old fridge with a new fridge.

Ignore the cost of buying a new fridge.

[2 marks]

Advantage .....

.....

Disadvantage .....

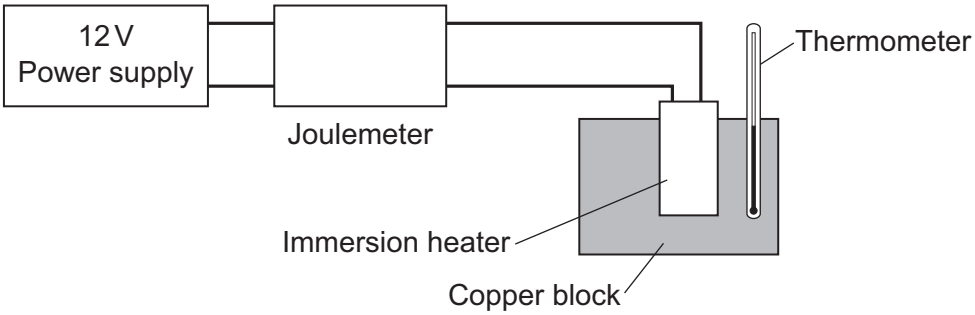
.....

8

Do not write outside the box

7 A student used the apparatus in **Figure 7** to obtain the data needed to calculate the specific heat capacity of copper.

Figure 7



The initial temperature of the copper block was measured.

The power supply was switched on.

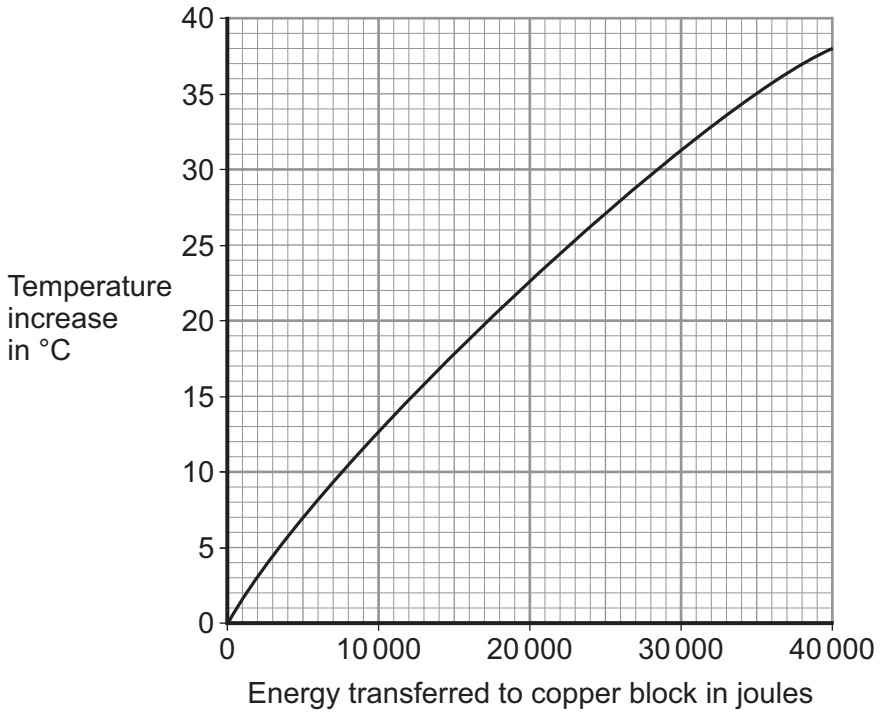
The energy transferred by the heater to the block was measured using the joulemeter.

The temperature of the block was recorded every minute.

The temperature increase was calculated.

Figure 8 shows the student's results.

Figure 8



Do not write outside the box

7 (a) Energy is transferred through the copper block.

What is the name of the process by which the energy is transferred?

Tick (✓) **one** box.

[1 mark]

Conduction ☐

Convection ☐

Radiation ☐

7 (b) Use **Figure 8** to determine how much energy was needed to increase the temperature of the copper block by 35 °C.

[1 mark]

..... joules

7 (c) The copper block has a mass of 2 kg.

Use your answer to part **(b)** to calculate the value given by this experiment for the specific heat capacity of copper. Give the unit.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

.....

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Specific heat capacity = ...

7 (d) This experiment does **not** give the correct value for the specific heat of copper.

Suggest **one** reason why.

[1 mark]

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6

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ANSWER IN THE SPACES PROVIDED

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8 **Table 2** shows information about different light bulbs.

The bulbs all have the same brightness.

Table 2

Type of bulb	Input power in watts	Efficiency
Halogen	40	0.15
Compact fluorescent (CFL)	14	0.42
LED	7	0.85

8 (a) (i) Calculate the useful power output of the CFL bulb.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Useful power output = ... watts

8 (a) (ii) Use your answer to part **(a)(i)** to calculate the waste energy produced each second by a CFL bulb.

[1 mark]

.....

Waste energy per second = ... joules

Question 8 continues on the next page

Do not write outside the box

8 (b) (i) A growth cabinet is used to investigate the effect of light on the rate of growth of plants.

Figure 9 shows a growth cabinet.

Figure 9



In the cabinet the factors that affect growth can be controlled.

A cooler unit is used to keep the temperature in the cabinet constant. The cooler unit is programmed to operate when the temperature rises above 20 °C.

The growth cabinet is lit using 50 halogen bulbs.

Changing from using halogen bulbs to LED bulbs would reduce the cost of running the growth cabinet.

Explain why.

[4 marks]

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Do not write outside the box

8 (b) (ii) A scientist measured the rate of growth of plants for different intensities of light.

What type of graph should be drawn to present the results?

[1 mark]

.....

Give a reason for your answer.

.....

.....

8 (c) **Table 3** gives further information about both a halogen bulb and an LED bulb.

Table 3

Type of bulb	Cost to buy	Lifetime in hours	Operating cost over the lifetime of one bulb
Halogen	£1.50	2 000	£16.00
LED	£30.00	48 000	£67.20

A householder needs to replace a broken halogen light bulb.

Compare the cost efficiency of buying and using halogen bulbs rather than an LED bulb over a time span of 48 000 hours of use.

Your comparison must include calculations.

[4 marks]

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12

END OF QUESTIONS

There are no questions printed on this page

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GCSE

SCIENCE A / PHYSICS

PH1HP

Mark scheme

4405/4403

June 2014

Version: 1.0 Final

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

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

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

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Information to Examiners

1. General

The mark scheme for each question shows:

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

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

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

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

2. Emboldening

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

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

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

3. Marking points

3.1 Marking of lists

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

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

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

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

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

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

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

3.2 Use of chemical symbols / formulae

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

3.3 Marking procedure for calculations

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

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

3.4 Interpretation of 'it'

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

3.5 Errors carried forward

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

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

3.6 Phonetic spelling

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

3.7 Brackets

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

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

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

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

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Quality of Written Communication and levels marking

In Question 2 candidates are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Candidates will be required to:

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

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

Level 1: basic

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

Level 2: clear

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

Level 3: detailed

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

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Question	Answers	Extra information	Mark	AO spec ref
1(a)	advantage any **one** from: • produce no / little greenhouse gases / carbon dioxide	allow produces no / little polluting gases allow doesn't contribute to global warming / climate change allow produce no acid rain / sulphur dioxide reference to atmospheric pollution is insufficient produce no harmful gases is insufficient	1	AO1 1.4.1a
	• high(er) energy density in fuel	accept one nuclear power station produces as much power as several gas power stations nuclear power stations can supply a lot of or more energy is insufficient		
	• long(er) operating life	allow saves using reserves of fossil fuels or gas		
	disadvantage any **one** from: • produce (long term) radioactive waste	accept waste is toxic accept nuclear for radioactive	1	
	• accidents at nuclear power stations may have far reaching or long term consequences			
	• high(er) decommissioning costs	accept high(er) building costs		
	• long(er) start up time			

Question 1 continues on the next page . . .

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Question 1 continued . . .

Question	Answers	Extra information	Mark	AO spec ref
1(b)(i)	12 000 (kWh)	allow **1** mark for correct substitution eg 2000 × 6 **or** 2 000 000 × 6 **or** $\frac{12\,000\,000}{1000}$ an answer of 12 000 000 scores **1** mark	2	AO2 1.3.1c
1(b)(ii)	any idea of unreliability, eg • wind is unreliable • shut down if wind too strong/weak • wind is variable	reference to weather alone is insufficient	1	AO1 1.4
1(c)	any **one** from: • cannot be seen • no hazard to (low flying) aircraft / helicopters • unlikely to be or not damaged / affected by (severe) weather • (normally) no / reduced shock hazard	unlikely to be damaged is insufficient safer is insufficient less maintenance is insufficient installed in urban areas is insufficient	1	AO1 1.4
Total			**6**	

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Question	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking.	Mark	AO spec ref
2		6	AO1 1.1.2a

0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)
No relevant content.	Considers either solid or gas and describes at least one aspect of the particles. **or** Considers both solids and gases and describes an aspect of each.	Considers both solids and gases and describes aspects of the particles. **or** Considers one state and describes aspects of the particles and explains at least one of the properties. **or** Considers both states and describes an aspect of the particles for both and explains a property for solids or gases.	Considers both states of matter and describes the spacing and movement / forces between the particles. Explains a property of both solids and gases.

examples of the points made in the response	extra information
Solids • (particles) close together • (so) no room for particles to move closer (so hard to compress) • vibrate about fixed point • strong forces of attraction (at a distance) • the forces become repulsive if the particles get closer • particles strongly held together/not free to move around (shape is fixed) **Gases** • (particles) far apart • space between particles (so easy to compress) • move randomly • negligible/no forces of attraction • spread out in all directions (to fill the container)	any explanation of a property must match with the given aspect(s) of the particles.

Total		6

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Question	Answers	Extra information	Mark	AO spec ref
3(a)	infrared / IR	correct answer only	1	AO1 1.1.1a
3(b)	any **two** from: • increase the power / watts • decrease the speed • put biscuits through again	 allow increase the temperature of the oven or make the oven hotter allow leave the biscuits in for longer increase radiation is insufficient ignore changes to the design of the oven	2	AO2 1.3.1c
3(c)	(inside) surface is a (good) reflector or poor absorber (of IR) (and) <u>outside</u> surface is poor emitter (of IR) (so) increases the energy reaching the biscuits	ignore bounce for reflect surface is a (good) reflector of light does not score surface is a (good) reflector of light and infrared / heat does score allow reduces energy loss or makes oven more efficient do **not** accept no energy losses keeps oven hotter is insufficient	1 1 1	AO1 1.1.1c, d
Total			**6**	

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Question	Answers	Extra information	Mark	AO spec ref
4(a)(i)	440 (sound) waves produced in one second	accept vibrations / oscillations for waves	1	AO1 1.5.1i
4(a)(ii)	0.773 (metres)	allow **2** marks for an answer that rounds to 0.773 allow **2** marks for an answer of 0.7$\dot{7}\dot{2}$ allow **2** marks for an answer of 0.772 allow **1** mark for correct substitution ie 340 = 440 × λ	3	AO2 1.5.1j
4(b)	(sound is) louder as amplitude is larger higher pitch/frequency as more waves are seen	do **not** accept the converse waves are taller is insufficient reference to wavelengths alone is insufficient waves are closer together is insufficient	1 1 1 1	AO1 AO3 1.5.3b
Total			**8**	

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Question	Answers	Extra information	Mark	AO spec ref
5(a)	water moves (from a higher level to a lower level) transferring GPE to KE rotating a turbine to turn a generator transferring KE to electrical energy	 accept driving or turning or spinning for rotating moving is insufficient transferring GPE to electrical energy gains **1** mark of the **2** marks available for energy transfers	1 1 1 1	AO1 1.4.1b
5(b)	(TVs in stand-by) use electricity generating electricity (from fossil fuels) produces CO_2 (CO_2) contributes to global warming	accept power / energy accept greenhouse gas accept sulfur dioxide accept climate change for global warming accept greenhouse effect if CO_2 given accept acid rain if linked to sulfur dioxide	1 1 1	AO1 AO2 1.4.1f
5(c)	a factor other than scientific is given, eg economic, political or legal	personal choice is insufficient	1	AO3 1.2
Total			**8**	

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Question	Answers	Extra information	Mark	AO spec ref
6(a)	air near freezer compartment is cooled or loses energy	accept air at the top is cold	1	AO1 1.1.3a
	cool air is (more) dense or particles close(r) together (than warmer air)	do **not** allow the particles get smaller / condense	1	
	so (cooler) air falls		1	
	air (at bottom) is displaced / moves upwards / rises	do **not** allow heat rises accept warm air (at the bottom) rises	1	
6(b)	if volume is doubled, energy use is not doubled **or** volume ÷ energy not a constant ratio		1	AO3 1.1.3
	correct reference to data, eg 500 is 2×250 but 630 not 2×300		1	
6(c)	accept suitable examples, eg			AO3 1.2
	advantage: • reduces emissions into atmosphere • lower input power or uses less energy or wastes less energy • costs less to run	cost of buying or installing new fridge is insufficient ignore reference to size of fridge	1	
	disadvantage: • land fill • energy waste in production • cost or difficulty of disposal • transport costs		1	
Total			**8**	

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Question	Answers	Extra information	Mark	AO spec ref
7(a)	conduction		1	AO1 1.1.3
7(b)	35 000		1	AO2 1.1.4a
7(c)	500 J/kg°C	their 7(b) = 2 x c x 35 correctly calculated scores **2** marks allow **1** mark for correct substitution, ie 35000 = 2 x c x 35 **or** their 7(b) = 2 x c x 35	2 1	AO1 AO2
7(d)	energy lost to surroundings **or** energy needed to warm heater	accept there is no insulation (on the copper block) do **not** accept answers in terms of human error or poor results or defective equipment	1	AO3 1.1.3d
Total			**6**	

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Question	Answers	Extra information	Mark	AO spec ref
8(a)(i)	5.88 (watts)	an answer of 5.9 scores **2** marks allow **1** mark for correct substitution ie $0.42 = \frac{\text{power out}}{14}$ allow **1** mark for an answer of 0.0588 or 0.059	2	AO2 1.2.1d
8(a)(ii)	8.12	allow 14 – their 8(a)(i) correctly calculated	1	AO2 1.2.1a
8(b)(i)	input power/energy would be (much) less (reducing cost of running)	accept the converse electricity is insufficient	1	AO1 AO2 1.2
	(also) produce less waste energy / power	accept 'heat' for waste energy	1	
	(as the waste energy / power) increases temperature of the cabinet		1	
	so cooler on for less time		1	
8(b)(ii)	line graph both variables are continuous	need to get both parts correct accept scattergram or scatter graph allow the data is continuous	1	AO3 1.2c

Question 8 continues on the next page . . .

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Question 8 continued . . .

Question	Answers	Extra information	Mark	AO spec ref
8(c)	number of bulbs used-halogen=24 (LED=1)		1	AO2 AO3 1.2
	total cost of LED = £30 + £67.20 = £97.20	accept a comparison of buying costs of halogen £36 and LED £30	1	
	total cost of halogen= 24 x £1.50 + 24 x £16.00 = £420 **or** buying cost of halogen is £36 **and** operating cost is £384	accept a comparison of operating costs of halogen £384 and LED £67.20 allow for **3** marks the difference in total cost is £322.80 if the number 24 has not been credited	1	
	statement based on correct calculations that overall LED is cheaper	must be **both** buying **and** operating costs	1	
	an alternative way of answering is in terms of cost per hour:			
	buying cost per hour for LED = $\left(\frac{£30.00}{48000}\right)$ = 0.0625p/£0.000625 buying cost per hour for halogen = $\left(\frac{£1.50}{2000}\right)$ = 0.075p/£0.00075	a calculation of both buying costs scores **1** mark		
	operating cost per hour for LED = $\left(\frac{£67.20}{48000}\right)$ = 0.14p/£0.0014 operating cost per hour for halogen = $\left(\frac{£16.00}{2000}\right)$ = 0.8p/£0.008	a calculation of both operating costs scores **1** mark		
	all calculations show a correct unit	**all** units correct scores **1** mark		
	statement based on correct calculations of **both** buying **and** operating costs, that overall LED is cheaper	correct statement scores **1** mark		
Total			**12**	

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

General Certificate of Secondary Education
Higher Tier
June 2013

Science A
Unit Physics P1

PH1HP

H

Physics
Unit Physics P1

Thursday 13 June 2013 9.00 am to 10.00 am

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

Time allowed
- 1 hour

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

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 4(a) should be answered in continuous prose. In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

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

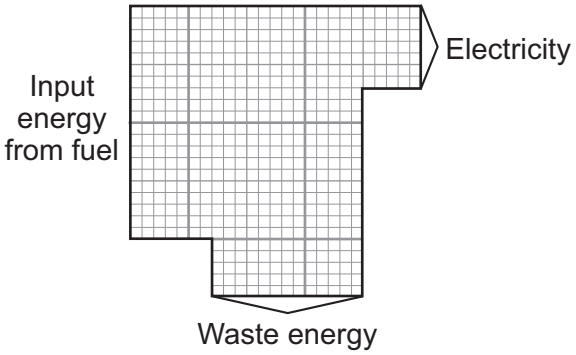
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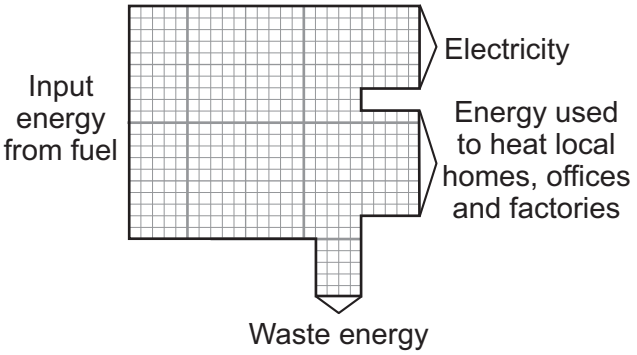
Answer **all** questions in the spaces provided.

1 The Sankey diagrams show the energy transfers in a traditional coal-burning power station and a combined heat and power (CHP) station.

Traditional coal-burning power station



CHP station



1 (a) What effect does the waste energy from a power station have on the surroundings?

.....

.....

(1 mark)

1 (b) Calculate the efficiency of the CHP station.

Use the correct equation from the Physics Equations Sheet.

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Efficiency = ...

(2 marks)

Do not write outside the box

1 (c) Why is a CHP station more efficient than a traditional coal-burning power station?

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(2 marks)

1 (d) A CHP station is usually used to meet the demand for electricity within the local area. The electricity is not transmitted and distributed through the National Grid.

1 (d) (i) What is the National Grid?

Tick (✓) **one** box.

A system of cables and pylons. ☐

A system of cables and transformers. ☐

A system of cables, transformers and power stations. ☐

(1 mark)

1 (d) (ii) Using the electricity locally and not transmitting it through the National Grid increases the overall efficiency of a CHP station by 7%.

Give **one** reason why.

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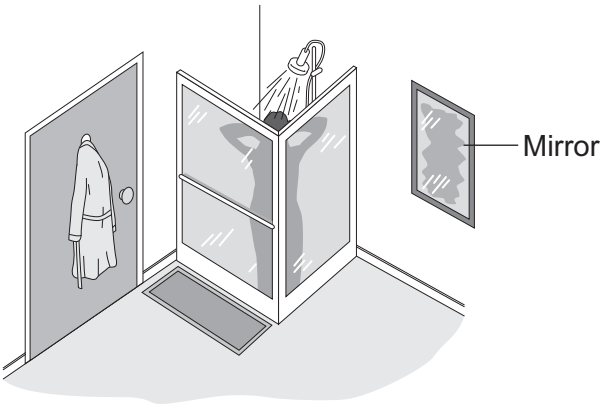
(1 mark)

7

Turn over for the next question

Do not write outside the box

2 The picture shows a person taking a hot shower.



2 (a) When a person uses the shower the mirror gets misty.

Why?

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(3 marks)

Do not write outside the box

2 (b) The homeowner installs an electrically heated mirror into the shower room.

When a person has a shower, the heated mirror does **not** become misty but stays clear.

Why does the mirror stay clear?

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(2 marks)

5

Turn over for the next question

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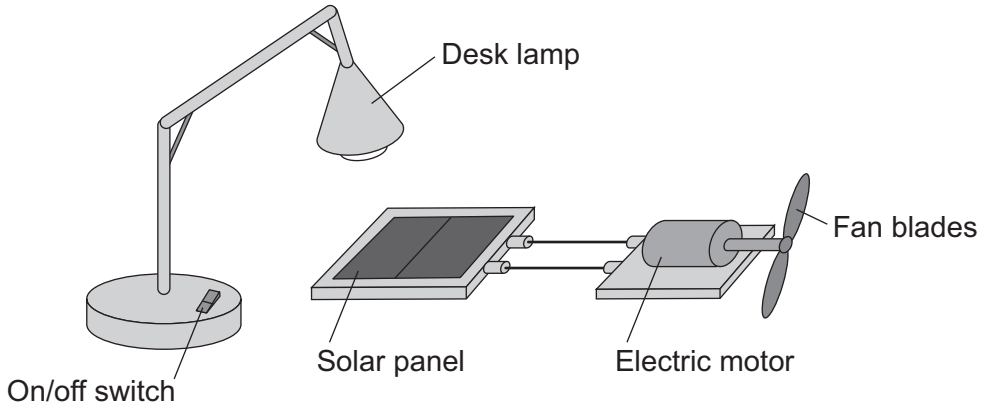
3 (a) Light waves transfer energy.

3 (a) (i) Complete the following sentence.

The oscillations producing a light wave are ..... to the direction of the energy transfer by the light wave.

(1 mark)

3 (a) (ii) The apparatus in the diagram shows that light waves transfer energy.



Describe how switching the desk lamp on and off shows that light waves transfer energy.

You do **not** need to describe the energy transfers.

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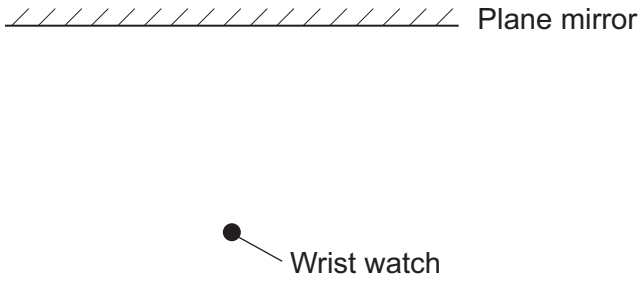
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(2 marks)

Do not write outside the box

3 (b) A student holds a wrist watch in front of a plane mirror. The student can see an image of the wrist watch in the mirror.

The diagram shows the position of the wrist watch and the mirror.



Draw a ray diagram showing how the image of the wrist watch is formed.

Mark the position of the image.

(4 marks)

3 (c) The image of the wrist watch seen by the student is virtual.

What is a virtual image?

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.....

(1 mark)

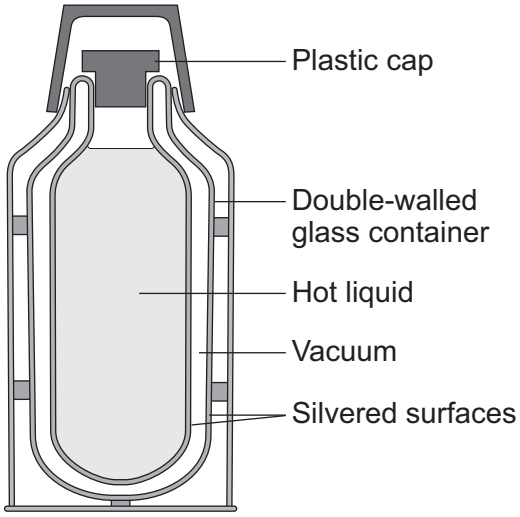
8

Turn over for the next question

Do not write outside the box

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

The diagram shows the structure of a vacuum flask.



A vacuum flask is designed to reduce the rate of energy transfer by heating processes.

Describe how the design of a vacuum flask keeps the liquid inside hot.

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(6 marks)

4 (b) Arctic foxes live in a very cold environment.



Arctic foxes have small ears.

How does the size of the ears help to keep the fox warm in a cold environment?

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(2 marks)

8

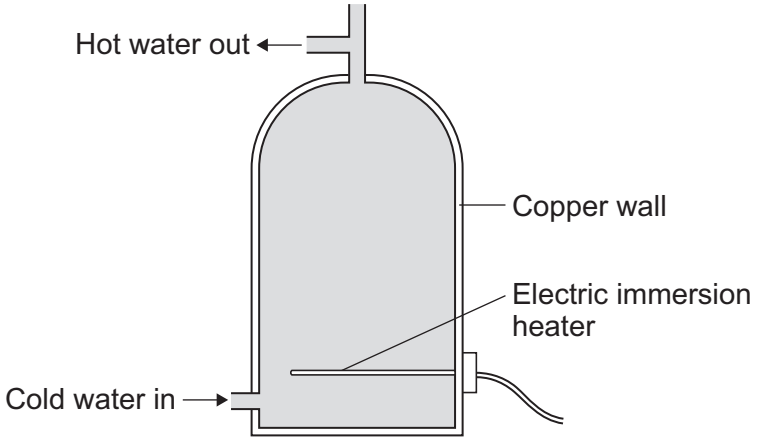
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ANSWER IN THE SPACES PROVIDED

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5 An electric immersion heater is used to heat the water in a domestic hot water tank. When the immersion heater is switched on the water at the bottom of the tank gets hot.



5 (a) Energy is transferred by the process of convection from the hot water at the bottom of the tank to the cooler water at the top.

Explain how.

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(4 marks)

5 (b) Complete the following sentence.

The main way the energy is transferred through the copper wall of the water tank is by the process of ..... .

(1 mark)

Question 5 continues on the next page

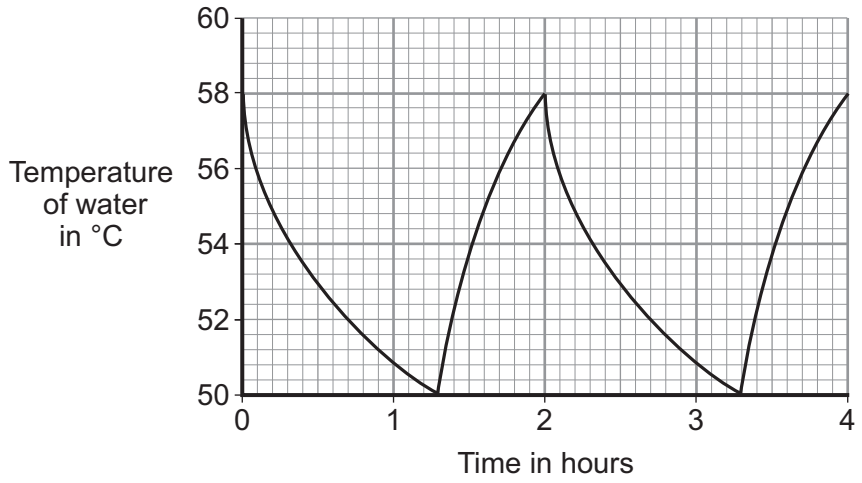
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5 (c) The immersion heater has a thermostat to control the water temperature.

When the temperature of the water inside the tank reaches 58°C the thermostat switches the heater off. The thermostat switches the heater back on when the temperature of the water falls to 50°C.

Graph A shows how the temperature of the water inside a hot water tank changes with time. The tank is **not** insulated.

Graph A (no insulation)



5 (c) (i) The temperature of the water falls at the fastest rate just after the heater switches off.

Explain why.

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(2 marks)

5 (c) (ii) To heat the water in the tank from 50°C to 58°C the immersion heater transfers 4032 kJ of energy to the water.

Calculate the mass of water in the tank.

Specific heat capacity of water = 4200 J/kg°C
Use the correct equation from the Physics Equations Sheet.

.....

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.....

Mass = ... kg

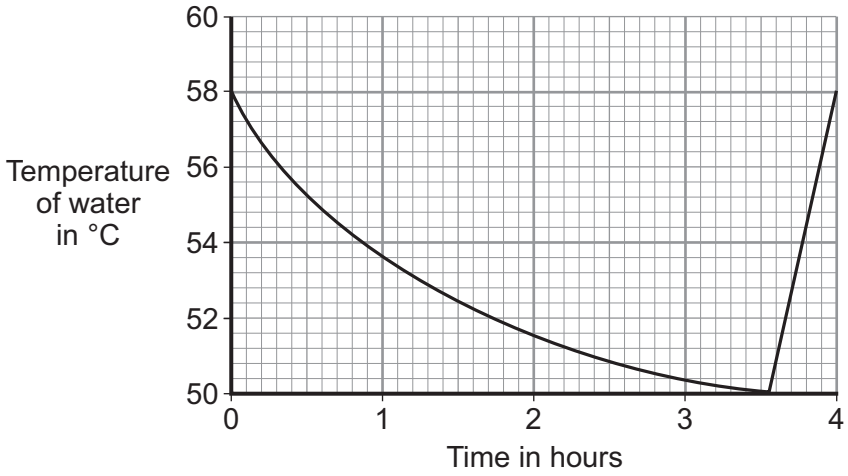
(3 marks)

Do not write outside the box

5 (c) (iii) An insulating jacket is fitted to the hot water tank.

Graph B shows how the temperature of the water inside the insulated hot water tank changes with time.

Graph B



An insulating jacket only costs £12.

By comparing **Graph A** with **Graph B**, explain why fitting an insulating jacket to a hot water tank saves money.

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(3 marks)

13

Turn over ▶

Do not write outside the box

6 (a) In the UK, over 70% of the electricity is generated in power stations that burn fossil fuels.

6 (a) (i) Explain **one** effect that burning fossil fuels has on the environment.

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(2 marks)

6 (a) (ii) Give **one** way the effect on the environment described in part **(a)(i)** could be reduced.

Assume the amount of fossil fuels burnt stays the same.

.....

.....

(1 mark)

6 (b) Electricity can also be generated in a pumped storage hydroelectric power station.

An advantage of pumped storage hydroelectric power stations is the short start-up time they have.

6 (b) (i) What is the importance of the short start-up time?

.....

.....

(1 mark)

6 (b) (ii) Give **one** other advantage of a pumped storage hydroelectric power station.

.....

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(1 mark)

Do not write outside the box

6 (c) Read the extract below from a newspaper article.

> In the future it may not be possible to have constant electricity. Families will have to get used to using power when it is available.

6 (c) (i) In the UK, the proportion of electricity generated using wind turbines is due to increase a lot. Some opponents of wind turbines think this increase will cause big fluctuations in the electricity supply.

Suggest **one** reason why this may be true.

.....

.....

(1 mark)

6 (c) (ii) Between 2002 and 2008 the amount of electricity used for lighting in homes in the UK decreased.

Suggest **one** reason why.

.....

.....

(1 mark)

7

Turn over for the next question

Do not write outside the box

7 (a) Electromagnetic waves form a continuous spectrum with a range of wavelengths.

What is the approximate range of wavelengths of electromagnetic waves?

Tick (✓) **one** box.

10^{-15} metres to 10^{4} metres ☐

10^{-4} metres to 10^{15} metres ☐

10^{-6} metres to 10^{6} metres ☐

(1 mark)

7 (b) Infrared waves and microwaves are used for communications.

7 (b) (i) Give **one** example of infrared waves being used for communication.

.....

.....

(1 mark)

7 (b) (ii) A mobile phone network uses microwaves to transmit signals through the air. The microwaves have a frequency of 1.8×10^{9} Hz and travel at a speed of 3.0×10^{8} m/s.

Calculate the wavelength of the microwaves.

Use the correct equation from the Physics Equations Sheet.

Give your answer to **two** significant figures.

.....

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.....

Wavelength = ... m

(3 marks)

Do not write outside the box

7 (c) Some scientists suggest there is a possible link between using a mobile phone and male fertility.

The results of their study are given in the table.

Mobile phone use in hours per day	Sperm count in millions of sperm cells per cm^3 of semen
0	86
less than 2	69
2 – 4	59
more than 4	50

The results show a negative correlation: the more hours a mobile phone is used each day, the lower the sperm count. However, the results do **not** necessarily mean using a mobile phone causes the reduced sperm count.

Suggest **one** reason why.

.....

.....

(1 mark)

6

Turn over for the next question

Do not write outside the box

8 (a) Observation of the spectra from distant galaxies provides evidence to support the 'Big Bang' theory.

8 (a) (i) Complete the following sentence.

Many scientists think that the 'Big Bang' theory describes the .....

..... .

(1 mark)

8 (a) (ii) Tick (✓) **one** box to complete the sentence.

The discovery of cosmic microwave background radiation was important

because it …

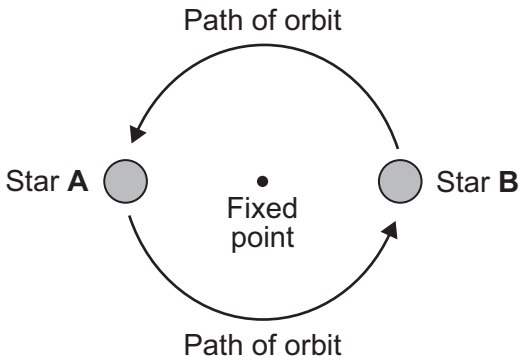
proved the 'Big Bang' theory to be correct. ☐

provided more evidence to support the 'Big Bang' theory. ☐

proved the Universe will continue to expand forever. ☐

(1 mark)

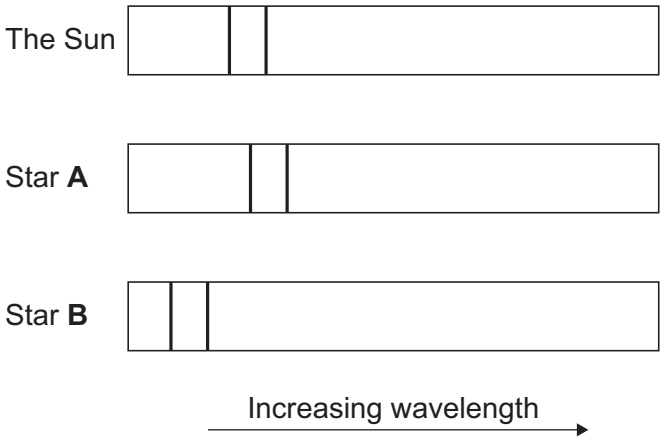
8 (b) Many stars are part of a binary star system. Binary star systems have two stars.



The visible spectrum from stars includes dark lines. These lines are at specific wavelengths.

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The diagram shows the position of two dark lines in the spectrum from the Sun. It also shows the same lines in the spectra from two stars **A** and **B** in a binary star system at the same point in time.



8 (b) (i) What name is given to the effect shown in the spectrum from star **A**?

.....

(1 mark)

8 (b) (ii) Scientists have concluded that the two stars in a binary star system orbit around a fixed point between the two stars.

A comparison of the spectra from the two stars in a binary star system provides evidence to support this conclusion.

Explain how.

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(3 marks)

6

END OF QUESTIONS

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Version 1.0



General Certificate of Secondary Education
June 2013

Science A / Physics PH1HP

(Specification 4405 / 4403)

Unit: Physics 1

Final

Mark Scheme

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

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

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

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Information to Examiners

1. General

The mark scheme for each question shows:

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

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

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

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

2. Emboldening

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

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

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

3. Marking points

3.1 Marking of lists

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

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

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

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

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

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

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

3.2 Use of chemical symbols / formulae

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

3.3 Marking procedure for calculations

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

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

3.4 Interpretation of 'it'

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

3.5 Errors carried forward

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

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

3.6 Phonetic spelling

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

3.7 Brackets

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

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

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

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

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Quality of Written Communication and levels marking

In Question 4(a) candidates are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Candidates will be required to:

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

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

Level 1: basic

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

Level 2: clear

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

Level 3: detailed

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

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Question 1

question	answers	extra information	mark
1(a)	warms it	do **not** accept answers in terms of waste gases **or** pollution	1
1(b)	80% **or** 0.8	answers of 80 **or** 0.8 plus a unit gain **1** mark **only** **or** allow **1** mark for a correct substitution, ie $\frac{16}{20}$ an answer of 35% **or** 0.35 gains **1** mark answers of 85%, 75%, 0.85 **or** 0.75 gain **1** mark	2
1(c)	some of the energy that would be wasted (by a coal-burning power station) is usefully used (to heat homes etc)	accept less waste energy accept energy used to heat homes etc	1 1
1(d)(i)	A system of cables and transformers		1
1(d)(ii)	less energy / power loss / wasted (in shorter cables)	accept no energy / power loss / wasted (in shorter cables) accept energy is lost when transmitted through cables do **not** accept electricity for energy	1
Total			**7**

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PH1HP

Question 2

question	answers	extra information	mark
2(a)	any **two** from: • water evaporates • water molecules / particles go into the air • mirror (surface) is cooler than (damp) air • water molecules / particles that hit the mirror lose energy • cooler air cannot hold as many water molecules / particles	accept steam / water vapour for water molecules accept water turns to steam accept the mirror / surface / glass is cold accept water molecules / particles that hit the mirror cool down	2
	(causes) condensation (on the mirror) **or** particles move closer together	accept steam changes back to water (on the mirror)	1
2(b)	mirror (surface) is warm	mirror is heated is insufficient	1
	(rate of) condensation reduced	accept no condensation (happens)	1
Total			**5**

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Question 3

question	answers	extra information	mark
3(a)(i)	perpendicular	accept correct description	1
3(a)(ii)	light off – no / slow rotation light on – fast(er) rotation	 accept starts rotating ignore references to energy transfers	1 1
3(b)	one ray drawn from wrist watch and reflected by mirror two rays drawn from wrist watch and reflected by mirror with i = r for both rays one ray traced back behind mirror image in correct position	accept solid or dashed lines judge angles by eye accept solid or dashed lines judged by eye accept image marked where two reflected rays traced back cross behind the mirror	1 1 1 1
3(c)	cannot be formed on a screen **or** rays of light seem to come from it but do not pass through it	accept image formed behind the mirror	1
Total			**8**

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Question 4

question	answers	extra information	mark
4(a)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5.		6

0 marks	**Level 1 (1–2 marks)**	**Level 2 (3–4 marks)**	**Level 3 (5–6 marks)**
No relevant content.	There is a basic explanation of **one** feature **or** a simple statement relating reduction in energy transfer to **one** feature.	There is a clear explanation of **one** feature **or** a simple statement relating reduction in energy transfer to **two** features.	There is a detailed explanation of at least **two** features **or** a simple statement relating reduction in energy transfer to all **four** features.

examples of the points made in response	**extra information**
plastic cap: • plastic is a poor conductor • stops convection currents forming at the top of the flask so stopping energy transfer by convection • molecules / particles evaporating from the (hot) liquid cannot move into the (surrounding) air so stops energy transfer by evaporation • plastic cap reduces / stops energy transfer by conduction / convection / evaporation glass container: • glass is a poor conductor so reducing energy transfer by conduction • glass reduces / stops energy transfer by conduction	accept throughout: heat for energy loss for transfer accept insulator for poor conductor

Question 4 continues on the next page . . .

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Question 4 continued . . .

question	answers	extra information	mark
	vacuum: • both conduction and convection require a medium / particles • so stops energy transfer between the two walls by conduction and convection • vacuum stops energy transfer by conduction / convection silvered surfaces: • silvered surfaces reflect infrared radiation • silvered surfaces are poor emitters of infrared radiation • infrared radiation (partly) reflected back (towards hot liquid) • silvered surfaces reduce / stop energy transfer by radiation	accept heat for infrared	
4(b)	(the ears have a) small <u>surface area</u>	ears are small is insufficient	1
	so reducing energy radiated / transferred (from the fox)	accept heat lost for energy radiated do **not** accept stops heat loss	1
Total			**8**

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Question 5

question	answers	extra information	mark
5(a)	(water) particles / molecules gain energy / move faster	accept atoms for molecules ignore move more do **not** accept move with a bigger amplitude / vibrate more	1
	and (the particles / molecules) move apart		1
	this causes the water to become less dense	accept water expands ignore particles become less dense	1
	and the warm / hot water rises (through the tank)	accept (more energetic water) particles rise to the top ignore heat rises	1
5(b)	conduction		1
5(c)(i)	there is a bigger temperature difference between the water and the surrounding air	accept the water is hottest / hotter	1
	so the transfer of energy (from hot water) is faster	accept heat for energy ignore temperature falls the fastest	1
5(c)(ii)	120	allow **1** mark for converting kJ to J correctly, ie 4 032 000 **or** correctly calculating temperature fall as 8°C **or** allow **2** marks for correct substitution, ie 4 032 000 = m × 4200 × 8 answers of 0.12, 19.2 **or** 16.6 gain **2** marks answers of 0.019 **or** 0.017 gain **1** mark	3

Question 5 continues on the next page . . .

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Question 5 continued . . .

question	answers	extra information	mark
5(c)(iii)	water stays hot for longer		1
	so heater is on for less time	accept so less energy needed to heat water	1
	(so cost of the jacket is soon recovered from) lower energy costs / bills	accept short payback time	1
Total			**13**

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Question 6

question	answers	extra information	mark
6(a)(i)	produces carbon dioxide / nitrogen oxides that (may) contribute to global warming	accept greenhouse gases ignore pollutant gases accept causes global warming damages ozone layer negates this mark accept alternative answers in terms of: sulfur dioxide / nitrogen oxides causing acid rain	1 1
6(a)(ii)	carbon capture / storage **or** plant more trees **or** remove sulfur (before burning fuel)	answer must relate to part (a)(i) collecting carbon dioxide is insufficient	1
6(b)(i)	(power station can be used) to meet surges in demand	accept starts generating in a short time can be switched on quickly is insufficient	1
6(b)(ii)	can store energy for later use	accept renewable (energy resource) accept does not produce CO_2 / SO_2 / pollutant gases	1

Question 6 continues on the next page . . .

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Question 6 continued . . .

question	answers	extra information	mark
6(c)(i)	turbines do not generate at a constant rate	accept wind (speed) fluctuates accept wind is (an) unreliable (energy source)	1
6(c)(ii)	any **one** from: • energy efficient lighting (developed / used) • increased energy cost (so people more likely to turn off) • more people becoming environmentally aware	use less lighting is insufficient accept electricity for energy	1
Total			**7**

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Question 7

question	answers	extra information	mark
7(a)	10^{-15} metres to 10^{4} metres		1
7(b)(i)	any **one** from: • (TV / video / DVD) remote controls • (short range) data transmission • optical fibre (signals)	mobile phones is insufficient accept specific example, eg linking computer peripherals do **not** accept Bluetooth	1
7(b)(ii)	0.17	an answer 17 cm gains **3** marks an answer given to more than 2 significant figures that rounds to 0.17 gains **2** marks allow **1** mark for correct substitution, ie $3 \times 10^{8} = 1.8 \times 10^{9} \times \lambda$	3
7(c)	(maybe) other factors involved	accept a named 'sensible' factor, eg higher stress / sedentary lifestyle / overweight / smoking more / diet / hot office / age not testing enough people is insufficient unreliable data is insufficient	1
Total			**6**

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Question 8

question	answers	extra information	mark
8(a)(i)	origin of the Universe	accept (why) the Universe is expanding do **not** accept origin of the Earth	1
8(a)(ii)	provided more evidence to support the 'Big Bang' theory		1
8(b)(i)	red-shift	accept Doppler (shift)	1
8(b)(ii)	(at the point in time shown the observed spectrum from) star A (shows it) is moving away from the Earth light from star B shows a decrease in wavelength so star B is moving towards Earth	accept star A is moving away star A shows red-shift is insufficient accept light from star B shows blue-shift accept light from star B shows an increase in frequency	1 1 1
Total			**6**

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	
7	
TOTAL	

General Certificate of Secondary Education
Higher Tier
January 2013

Science A
Unit Physics P1

PH1HP

H

Physics
Unit Physics P1

Thursday 17 January 2013 1.30 pm to 2.30 pm

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

Time allowed
- 1 hour

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

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 3(b) should be answered in continuous prose. In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

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

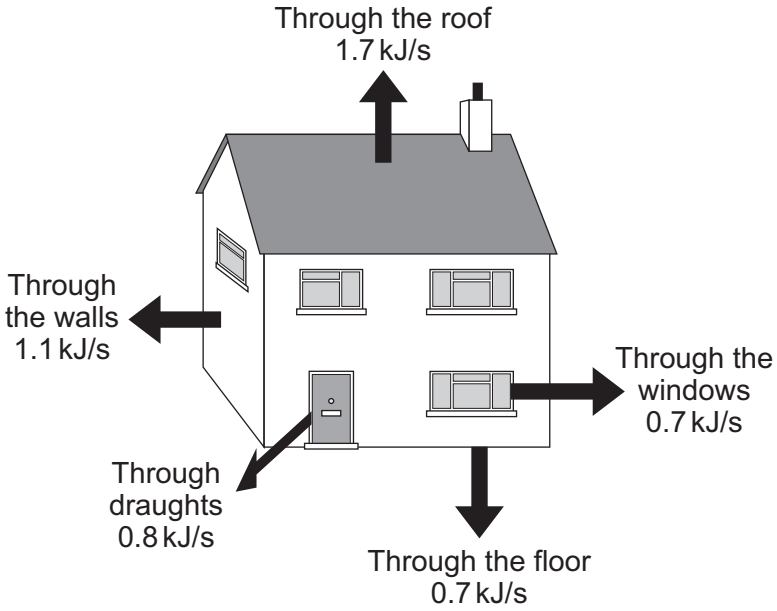
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Do not write outside the box

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

1 **Diagram 1** shows the energy transferred per second from a badly insulated house on a cold day in winter.

Diagram 1



1 (a) (i) When the inside of the house is at a constant temperature, the energy transferred from the heating system to the inside of the house equals the energy transferred from the house to the outside.

Calculate, in kilowatts, the power of the heating system used to keep the inside of the house in **Diagram 1** at a constant temperature.

1 kilowatt (kW) = 1 kilojoule per second (kJ/s)

.....

Power of the heating system = ... kW

(1 mark)

Do not write outside the box

1 (a) (ii) In the winter, the heating system is switched on for a total of 7 hours each day.

Calculate, in kilowatt-hours, the energy transferred each day from the heating system to the inside of the house.

Use the correct equation from the Physics Equations Sheet.

.....

.....

Energy transferred each day = ... kWh

(2 marks)

1 (a) (iii) Energy costs 15 p per kilowatt-hour.

Calculate the cost of heating the house for one day.

.....

Cost = ...

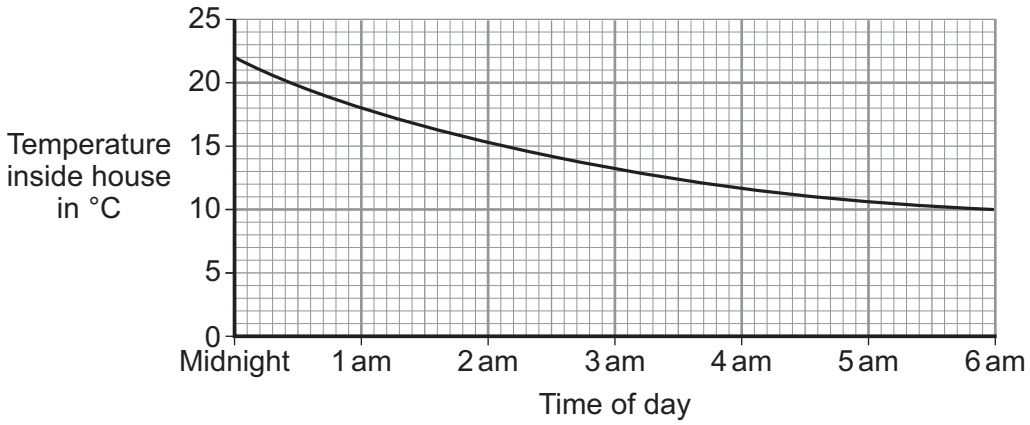
(1 mark)

Question 1 continues on the next page

Do not write outside the box

1 (a) (iv) The heating system is switched off at midnight.

The graph shows how the temperature inside the house changes after the heating system has been switched off.



Draw a ring around the correct answer in the box to complete the sentence.

Between midnight and 6 am the rate of energy transfer from

the house

decreases.
decreases then stays constant.
increases.

Give the reason for your answer.

.....

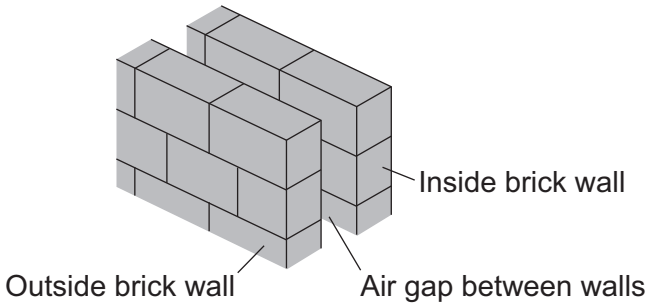
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(2 marks)

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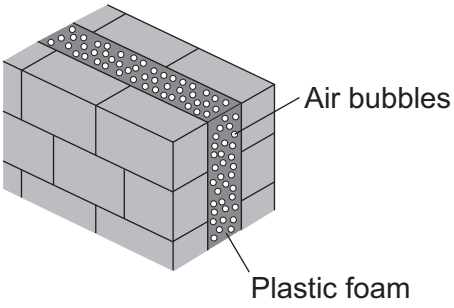
1 (b) **Diagram 2** shows how the walls of the house are constructed.
Diagram 3 shows how the insulation of the house could be improved by filling the air gap between the two brick walls with plastic foam.

Diagram 2



U-value of the wall = 0.7

Diagram 3



U-value of the wall = 0.3

1 (b) (i) The plastic foam reduces energy transfer by convection.

Explain why.

.....

.....

.....

.....

(2 marks)

1 (b) (ii) Filling the air gap with plastic foam reduces the U-value of the wall.

What is meant by the term *U-value*?

.....

.....

(1 mark)

Question 1 continues on the next page

Do not write outside the box

1 (c) A homeowner has part of the outside wall of her house removed and replaced with double-glazed glass doors.

U-value of the wall = 0.3
U-value of glass doors = 1.8

Explain the effect of replacing part of the outside wall with glass doors on the rate of energy transfer from the house.

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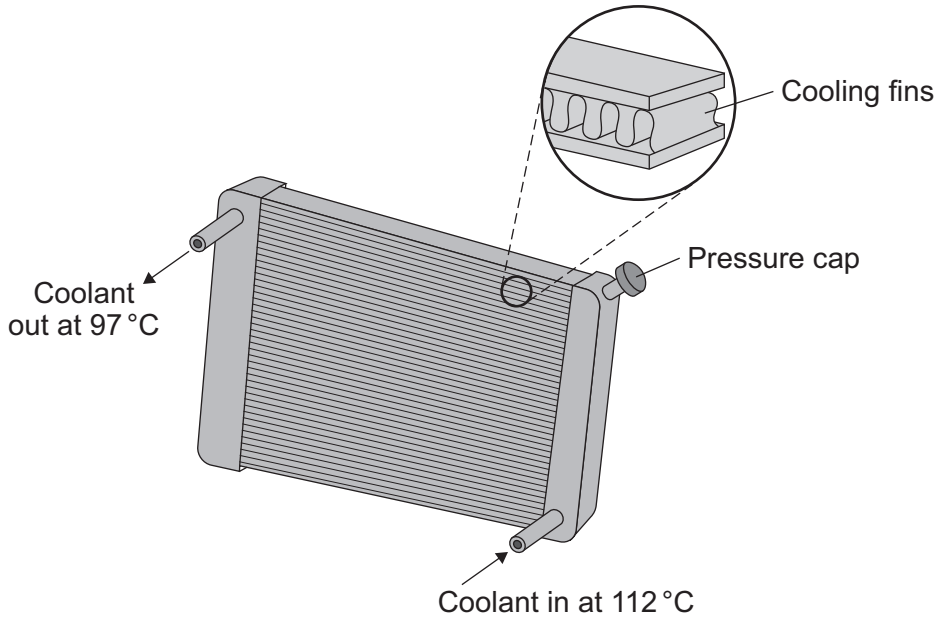
.....

(2 marks)

11

Do not write outside the box

2 The diagram shows a car radiator. The radiator is part of the engine cooling system.



Liquid coolant, heated by the car engine, enters the radiator. As the coolant passes through the radiator, the radiator transfers energy to the surroundings and the temperature of the coolant falls.

2 (a) Why is the radiator painted black?

.....

.....

.....

.....

(2 marks)

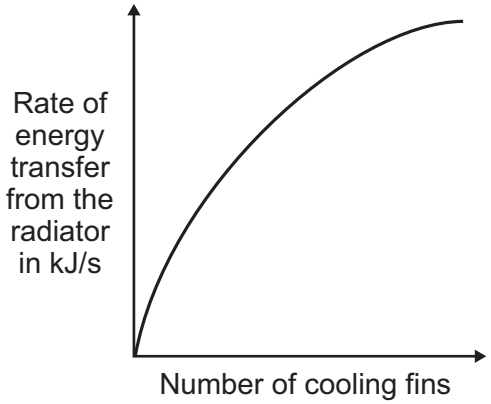
Question 2 continues on the next page

Turn over ▶

Do not write outside the box

2 (b) Different radiators have different numbers of cooling fins along the length of the radiator.

The sketch graph shows how the number of cooling fins affects the rate of energy transfer from the radiator.



The number of cooling fins affects the rate of energy transfer from the radiator.

Explain how.

.....

.....

.....

.....

(2 marks)

Do not write outside the box

2 (c) When the car engine is working normally, 2 kg of coolant passes through the radiator each second. The temperature of the coolant falls from 112 °C to 97 °C.

Calculate the energy transferred each second from the coolant.

Specific heat capacity of the coolant = 3800 J/kg °C.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

.....

Energy transferred each second = ... J

(3 marks)

2 (d) On cold days, some of the energy transferred from a hot car engine is used to warm the air inside the car. This is a useful energy transfer.

What effect, if any, does this energy transfer have on the overall efficiency of the car engine?

Draw a ring around the correct answer.

decreases the efficiency	**does not change the efficiency**	**increases the efficiency**

Give a reason for your answer.

.....

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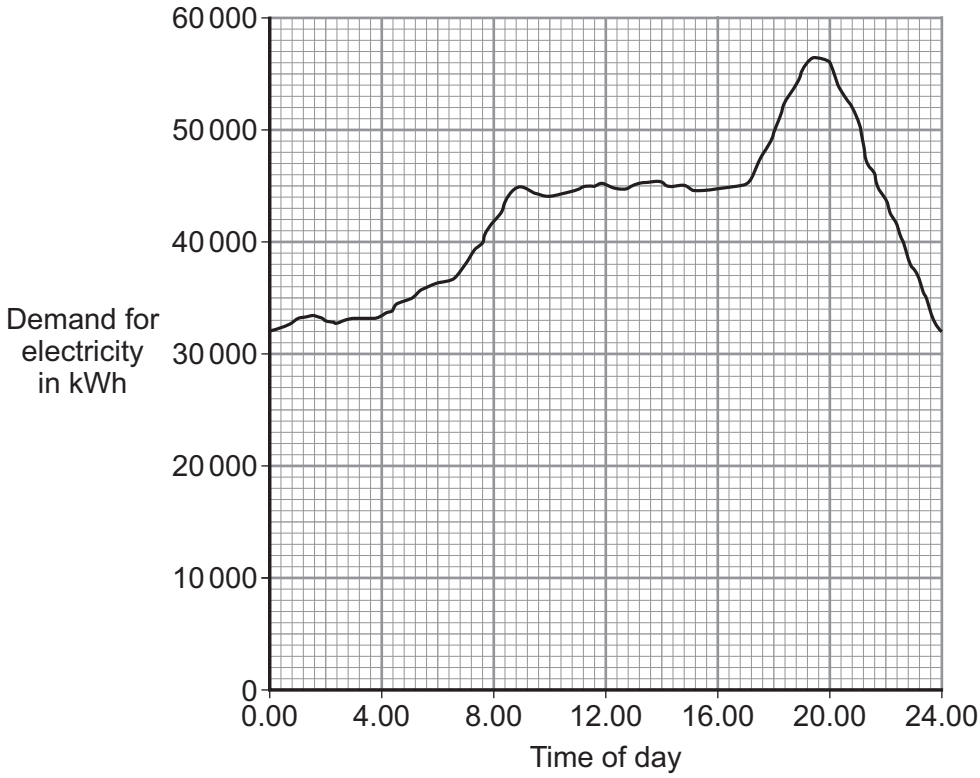
(2 marks)

9

Turn over for the next question

Do not write outside the box

3 (a) The graph shows how the demand for electricity in the UK changes during one 24-hour period.



The table gives the start-up times for two types of power station.

Type of power station	Start-up time
Gas	A few minutes
Nuclear	Several days

How would these two types of power station be used to meet the demand for electricity during this 24-hour period?

.....

.....

.....

.....

.....

.....

(3 marks)

Do not write outside the box

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

A farmer plans to generate all the electricity needed on her farm, using either a biogas generator or a small wind turbine.

The biogas generator would burn methane gas. The methane gas would come from rotting the animal waste produced on the farm. When burnt, methane produces carbon dioxide.

The biogas generator would cost £18 000 to buy and install. The wind turbine would cost £25 000 to buy and install.

The average power output from the wind turbine would be the same as the continuous output from the biogas generator.

Evaluate the advantages and disadvantages of the two methods of generating electricity.

Conclude, with a reason, which system would be better for the farmer to buy and install.

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(6 marks)

9

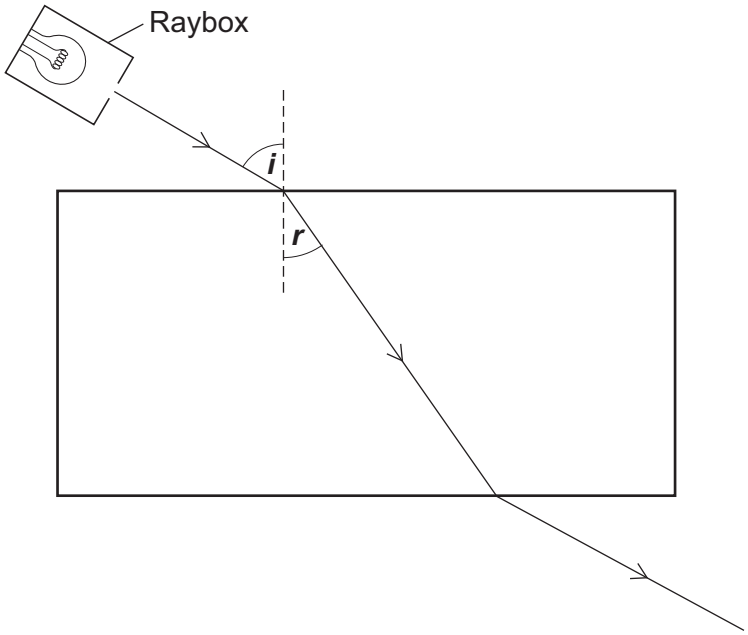
Turn over ▶

Do not write outside the box

4 A student investigated the refraction of light as it passes into and out of a clear plastic block.

Diagram 1 shows the apparatus the student used.

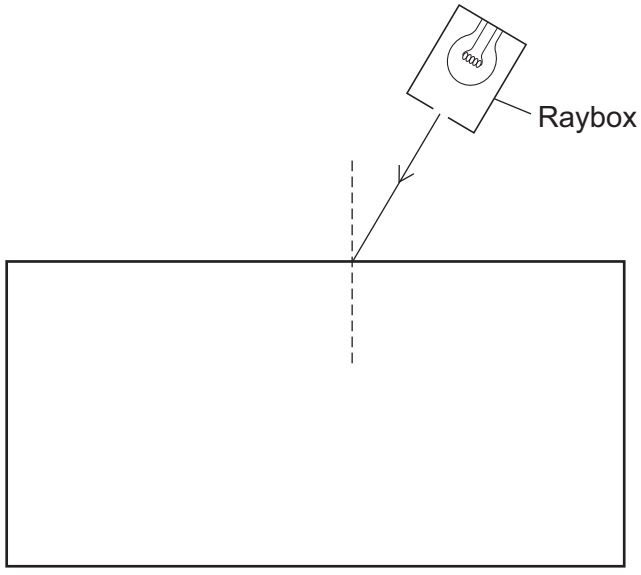
Diagram 1



4 (a) **Diagram 2** shows the same apparatus.

Use a ruler to draw on **Diagram 2** the path of the light ray.

Diagram 2



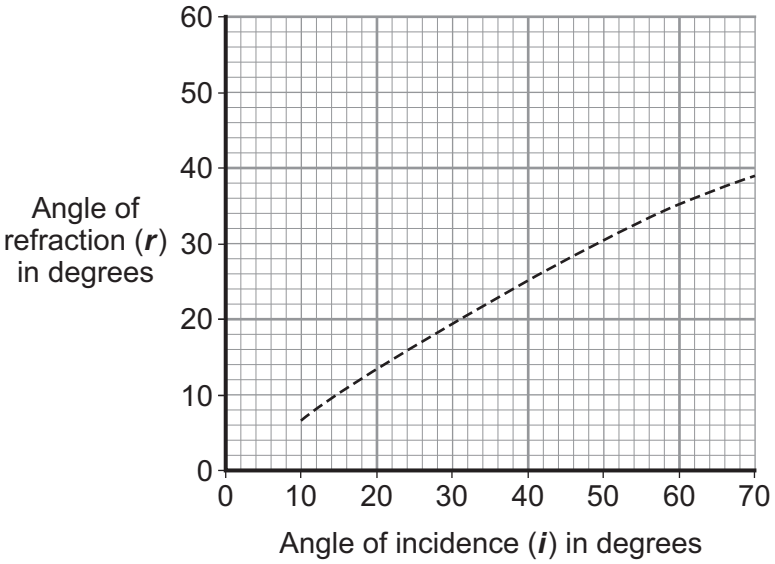
(2 marks)

Do not write outside the box

4 (b) The student measured the angle of refraction (***r***) for different angles of incidence (***i***) for light entering the plastic block.

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

Graph 1



4 (b) (i) What **two** conclusions can be made about the relationship between the angle of incidence and the angle of refraction from **Graph 1**?

1 .....

.....

2 .....

.....

(2 marks)

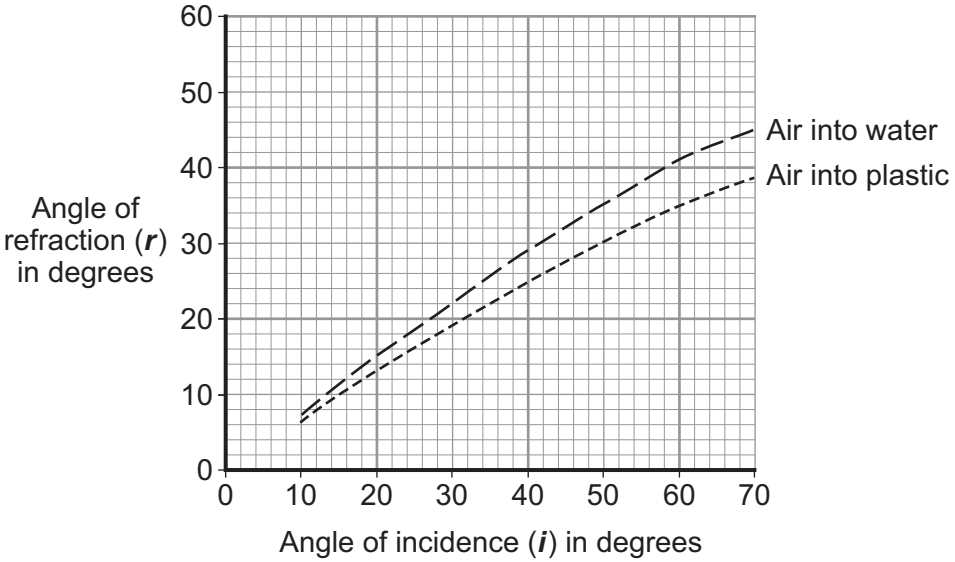
Question 4 continues on the next page

Turn over ▶

Do not write outside the box

4 (b) (ii) **Graph 2** shows the student's results for light passing from air into plastic. The graph also shows the results for light passing from air into water.

Graph 2



How does the refraction of light passing from air into water compare to the refraction of light passing from air into plastic?

.....

.....

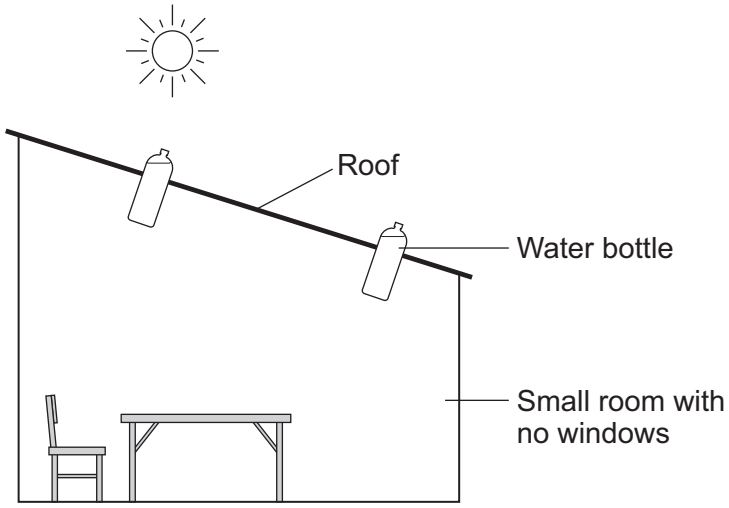
(1 mark)

Do not write outside the box

4 (c) In some countries people are too poor to pay for electricity. Some people living in small houses with no natural light are using bottles filled with water instead of light bulbs.

The bottles are fitted into small holes in the roof of the house. Sunlight refracts as it passes into and out of the bottle, causing light to spread into the room. This simple device gives about the same amount of light as a 50 W light bulb.

Diagram 3



4 (c) (i) Suggest **one** way this simple device can help improve the lives of the people using it.

.....

.....

(1 mark)

4 (c) (ii) The increasing use of energy resources to generate electricity within developed countries has ethical implications.

Suggest **one** ethical implication.

.....

.....

(1 mark)

7

Turn over for the next question

Do not write outside the box

5 Galaxies emit all types of electromagnetic wave.

5 (a) (i) Which type of electromagnetic wave has the shortest wavelength?

.....

(1 mark)

5 (a) (ii) State **one** difference between an ultraviolet wave and a visible light wave.

.....

.....

(1 mark)

5 (b) Electromagnetic waves travel through space at a speed of 3.0×10^8 m/s.

The radio waves emitted from a distant galaxy have a wavelength of 25 metres.

Calculate the frequency of the radio waves emitted from the galaxy and give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Frequency = ...

(3 marks)

5 (c) Scientists use a radio telescope to measure the wavelength of the radio waves emitted from the galaxy in part **(b)** as the waves reach the Earth. The scientists measure the wavelength as 25.2 metres. The effect causing this observed increase in wavelength is called red-shift.

5 (c) (i) The waves emitted from most galaxies show red-shift.

What does red-shift tell scientists about the direction most galaxies are moving?

.....

.....

(1 mark)

Do not write outside the box

5 (c) (ii) The size of the red-shift is **not** the same for all galaxies.

What information can scientists find out about a galaxy when they measure the size of the red-shift the galaxy produces?

.....

.....

.....

.....

(2 marks)

5 (c) (iii) What does the observation of red-shift suggest is happening to the Universe?

.....

.....

(1 mark)

9

Turn over for the next question

Do not write outside the box

6 About half of the UK's electricity is generated in coal-burning power stations and nuclear power stations.

6 (a) Coal-burning power stations and nuclear power stations provide a reliable way of generating electricity.

What is meant by *a reliable way of generating electricity*?

.....

.....

(1 mark)

6 (b) Over the next few years, most of the older nuclear power stations in the UK will be closed down, and the process of decommissioning will start.

What does it mean to *decommission* a nuclear power station?

.....

.....

(1 mark)

6 (c) Climate change has been strongly linked to the emission of carbon dioxide. Many governments around the world are committed to reducing carbon dioxide emissions.

Generating electricity can increase carbon dioxide emissions.

The companies generating electricity could reduce carbon dioxide emissions.

Give **two** ways the companies could do this.

1 .....

.....

2 .....

.....

(2 marks)

Do not write outside the box

6 (d) Electricity is distributed from power stations to consumers along the National Grid.

The voltage across the overhead cables of the National Grid needs to be much higher than the output voltage from the power station generators.

Explain why.

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(3 marks)

7

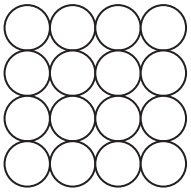
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7 According to kinetic theory, all matter is made up of small particles. The particles are constantly moving.

Diagram 1 shows how the particles may be arranged in a solid.

Diagram 1



7 (a) One kilogram of a gas has a much larger volume than one kilogram of a solid.

Use kinetic theory to explain why.

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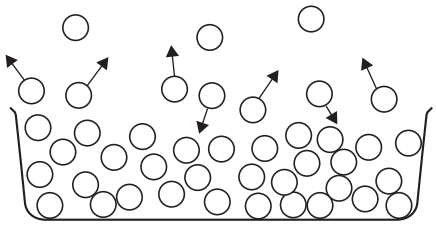
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(4 marks)

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7 (b) **Diagram 2** shows the particles in a liquid. The liquid is evaporating.

Diagram 2



7 (b) (i) How can you tell from **Diagram 2** that the liquid is evaporating?

.....

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(1 mark)

7 (b) (ii) The temperature of the liquid in the container decreases as the liquid evaporates.

Use kinetic theory to explain why.

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(3 marks)

8

END OF QUESTIONS

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Version 1.0



General Certificate of Secondary Education
January 2013

Science A / Physics (Specification 4405 / 4403)

PH1HP

Unit: Physics 1

Final

Mark Scheme

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

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

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

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Information to Examiners

1. General

The mark scheme for each question shows:

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

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

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

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

2. Emboldening

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

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

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

3. Marking points

3.1 Marking of lists

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

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

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

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

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

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

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

3.2 Use of chemical symbols / formulae

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

3.3 Marking procedure for calculations

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

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

3.4 Interpretation of 'it'

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

3.5 Errors carried forward

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

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

3.6 Phonetic spelling

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

3.7 Brackets

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

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

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

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

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Quality of Written Communication and levels marking

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

Candidates will be required to:

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

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

Level 1: basic

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

Level 2: clear

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

Level 3: detailed

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

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Question 1

question	answers	extra information	mark
1(a)(i)	5(.0)		1
1(a)(ii)	35 **or** their (a)(i) × 7 correctly calculated	allow **1** mark for correct substitution, ie 5 **or** their (a)(i) × 7 provided no subsequent step shown	2
1(a)(iii)	525(p) **or** (£) 5.25 **or** their (a)(ii) × 15 correctly calculated	if unit p or £ given they must be consistent with the numerical answer	1
1(a)(iv)	decreases temperature difference (between inside and outside) decreases	 accept gradient (of line) decreases do **not** accept temperature (inside) decreases do **not** accept graph goes down	1 1
1(b)(i)	air (bubbles are) trapped (in the foam) (and so the) air cannot circulate / move / form convection current	do **not** accept air traps heat foam has air pockets is insufficient air is a good insulator is insufficient no convection current is insufficient answers in term of warm air from the room being trapped are incorrect and score no marks	1 1

Question 1 continues on the next page . . .

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Question 1 continued . . .

question	answers	extra information	mark
1(b)(ii)	how effective / good a material is as an insulator / at keeping energy in	accept heat for energy accept the lower the U-value the better the insulator accept the lower the U-value the lower the rate of energy / heat transfer	1
1(c)	it will increase because the glass is not (such) a good insulator (as the wall)	room will be cooler is insufficient the U-value has increased is insufficient	1 1
Total			**11**

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Question 2

question	answers	extra information	mark
2(a)	(matt) black is a good <u>emitter</u> of infrared / radiation	accept heat for infrared / radiation ignore reference to good absorber attracts heat negates this marking point	1
	to give maximum (rate of) energy transfer (to surroundings)	accept temperature (of coolant) falls fast(er) accept black emits more radiation for **1** mark black emits most radiation / black is the best emitter of radiation for **2** marks	1
2(b)	the fins increase the surface area	accept heat for energy	1
	so increasing the (rate of) energy transfer **or** so more fins greater (rate of) energy transfer		1
2(c)	114 000	allow **1** mark for correct temperature change, ie 15 (°C) **or** allow **2** marks for correct substitution, ie 2 × 3800 × 15 answers of 851 200 **or** 737 200 gain **2** marks **or** substitution 2 × 3800 × 112 **or** 2 × 3800 × 97 gains **1** mark an answer of 114 kJ gains **3** marks	3

Question 2 continues on the next page . . .

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Question 2 continued . . .

question	answers	extra information	mark
2(d)	increases the efficiency		1
	less (input) energy is wasted **or** more (input) energy is usefully used	accept some of the energy that would have been wasted is (usefully) used accept heat for energy	1
Total			**9**

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Question 3

question	answers	extra information	mark
3(a)	any **three** from: • gas can be switched on (and off) quickly but nuclear cannot • gas can be used to meet surges in demand • gas can contribute to / meet the base load • nuclear provides base load **or** nuclear is used to generate all of the time	gas has a short start-up time alone is insufficient accept specific times from graph, anything from 1700 to 2200	3

3(b)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking.			6
0 marks	**Level 1 (1-2 marks)**	**Level 2 (3-4 marks)**	**Level 3 (5-6 marks)**	
No relevant content.	There is a brief description of one advantage **or** disadvantage of using either biogas or wind **or** makes a conclusion with a reason.	There is a description of some advantages **and / or** disadvantages for biogas **and / or** wind **or** there is a direct comparison between the two systems **and** at least one advantage / disadvantage **or** a detailed evaluation of one system only with a conclusion.	There is a clear and detailed comparison of the two systems. There must be a clear conclusion of which system would be best with at least one comparative reason given for the choice made.	

Question 3 continues on the next page . . .

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Question 3 continued . . .

examples of the points made in the response	extra information
Biogas	
• renewable	
• energy resource is free	
• reliable energy source	accept works all of the time
• does not depend on the weather	
• uses up (animal) waste products	
• concentrated energy source	
• cheaper (to buy and install)	accept once only
• shorter payback-time (than wind)	
• adds carbon dioxide to the atmosphere	when waste burns it produces carbon dioxide is insufficient
• contributes to the greenhouse effect **or** contributes to global warming	
• no transport cost for fuels	
Wind turbine	
• renewable	
• energy resource is free	
• not reliable	
• depends on the weather / wind	
• will be times when not enough electricity generated for the farm's needs	
• dilute energy source	
• longer payback-time (than biogas)	
• more expensive (to buy and install)	accept once only
• does not produce any carbon dioxide	accept pollutant gases for carbon dioxide accept does not pollute air
	produces visual or noise pollution is insufficient harmful gases is insufficient

Total			**9**

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Question 4

question	answers	extra information	mark
4(a)	refracted into the block, angle r < i refracted correctly out of block, two rays in air parallel	 judge by eye if first mark not scored allow **1** mark for correct refraction shown as ray leaves the block	1 1
4(b)(i)	the angle of refraction is (always) less than the angle of incidence the angle of refraction increases as the angle of incidence increases	 accept angle i and angle r are **not** directly proportional accept there is positive correlation	1 1
4(b)(ii)	(for the same angle of incidence) the angle of refraction in plastic is less than the angle of refraction in water	accept (for the same angle of incidence) plastic refracts light more than water accept it is less	1
4(c)(i)	accept any sensible suggestion to do with being able to see inside (during daylight hours) eg able to (see to) work / cook inside	accept to see what they are doing lights up the room is insufficient ignore no need to pay for electricity	1
4(c)(ii)	accept any <u>ethical</u> suggestion, eg • fair access to energy for all • unequal use of energy resources • consequences for the future of decisions made now • damage to global environment affects all	 damage to the environment is insufficient	1
Total			**7**

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Question 5

question	answers	extra information	mark
5(a)(i)	gamma	accept correct symbol	1
5(a)(ii)	any **one** from: • (ultraviolet has a) higher frequency • (ultraviolet has a) greater energy • (ultraviolet has a) shorter wavelength	ultraviolet cannot be seen is insufficient ignore ultraviolet causes cancer etc	1
5(b)	1.2×10^7 / 12 000 000 hertz / Hz / kHz / MHz	allow **1** mark for correct substitution, ie $3 \times 10^8 = f \times 25$ do **not** accept hz **or** HZ answers 12 000 kHz **or** 12 MHz gain **3** marks for full credit the numerical answer and unit must be consistent	2 1
5(c)(i)	away (from each other)	accept away (from the Earth) accept receding	1
5(c)(ii)	distance (from the Earth) speed galaxy is moving	accept how far away (it is)	1 1
5(c)(iii)	(Universe is) expanding		1
Total			**9**

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Question 6

question	answers	extra information	mark
6(a)	any **one** from: • energy / source is constant • energy / source does not rely on uncontrollable factors • can generate all of the time	accept a specific example, eg the weather will not run out is insufficient	1
6(b)	(dismantle and) remove radioactive waste / materials / fuel	accept nuclear for radioactive knock down / shut down is insufficient	1
6(c)	any **two** from: • reduce use of fossil fuelled power stations • use more nuclear power • use (more) renewable energy sources • make power stations more efficient • (use) carbon capture (technology)	accept specific fossil fuel accept use less fossil fuel accept build new nuclear power stations accept a named renewable energy source do **not** accept natural for renewable do **not** accept use less non-renewable (energy) sources	2
6(d)	(by increasing the voltage) the current is reduced this reduces the energy / power loss (from the cable) and this increases the efficiency (of transmission)	 accept reduces amount of waste energy accept heat for energy do **not** accept stops energy loss	1 1 1
Total			**7**

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Question 7

question	answers	extra information	mark
7(a)	there are strong forces (of attraction) between the particles in a solid	accept molecules / atoms for particles throughout accept bonds for forces	1
	(holding) the particles close together **or** (holding) the particles in a fixed pattern / positions	particles in a solid are less spread out is insufficient	1
	but in a gas the forces between the particles are negligible	accept very small / zero for negligible accept bonds for forces	1
	so the particles spread out (to fill their container)	accept particles are not close together gas particles are not in a fixed position is insufficient	1
7(b)(i)		accept molecules / atoms for particles throughout	
	particles are (shown) leaving (the liquid / container)	accept particles are escaping particles are getting further apart is insufficient	1
7(b)(ii)		accept molecules / atoms for particles throughout accept speed / velocity for energy throughout	
	particles with most energy leave the (surface of the) liquid	accept fastest particles leave the liquid	1
	so the <u>mean / average</u> energy of the remaining particles goes down		1
	and the lower the average energy (of the particles) the lower the temperature (of the liquid)		1
Total			**8**

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	
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6	
7	
8	
TOTAL	

General Certificate of Secondary Education
Higher Tier
June 2012

Science A
Unit Physics P1

PH1HP

H

Physics
Unit Physics P1

Wednesday 20 June 2012 9.00 am to 10.00 am

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

You may use a calculator.

Time allowed
- 1 hour

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

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 3(b) should be answered in continuous prose. In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

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

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Do not write outside the box

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

1 A wood burning stove is used to heat a room.



The fire in the stove uses wood as a fuel. The fire heats the matt black metal case of the stove.

1 (a) The air next to the stove is warmed by infrared radiation.

How does the design of the stove help to improve the rate of energy transfer by infrared radiation?

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(2 marks)

Do not write outside the box

1 (b) Burning 1 kg of wood transfers 15 MJ of energy to the stove. The stove then transfers 13.5 MJ of energy to the room.

Calculate the efficiency of the stove.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

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Efficiency = ...

(2 marks)

1 (c) Some of the energy from the burning wood is wasted as the hot gases leave the chimney and warm the air outside the house.

Name **one** other way energy is wasted by the stove.

.....

(1 mark)

1 (d) Some people heat their homes using electric heaters. Other people heat their homes using a wood burning stove.

Give **two** environmental advantages of using a wood burning stove to heat a home rather than heaters that use electricity generated from fossil fuels.

1 .....

.....

2 .....

.....

(2 marks)

Question 1 continues on the next page

Do not write outside the box

1 (e) The metal case of the stove gets hot when the fire is lit.

Here is some information about the stove.

Mass of metal case	100 kg
Starting temperature of metal case	20 °C
Final temperature of metal case	70 °C
Specific heat capacity of metal case	510 J/kg °C

Calculate the energy required to raise the temperature of the metal case to 70 °C.

Use the correct equation from the Physics Equations Sheet.

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

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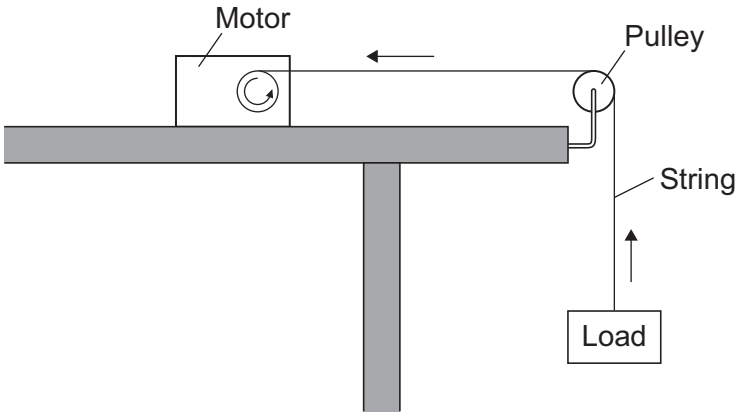
Energy required = ...

(3 marks)

10

Do not write outside the box

2 A student uses an electric motor to lift a load.



In the motor, the electrical energy is transferred into other types of energy. Some of this energy is useful and the rest of the energy is wasted.

2 (a) (i) Name the useful energy output from the electric motor.

.....

(1 mark)

2 (a) (ii) What eventually happens to the wasted energy?

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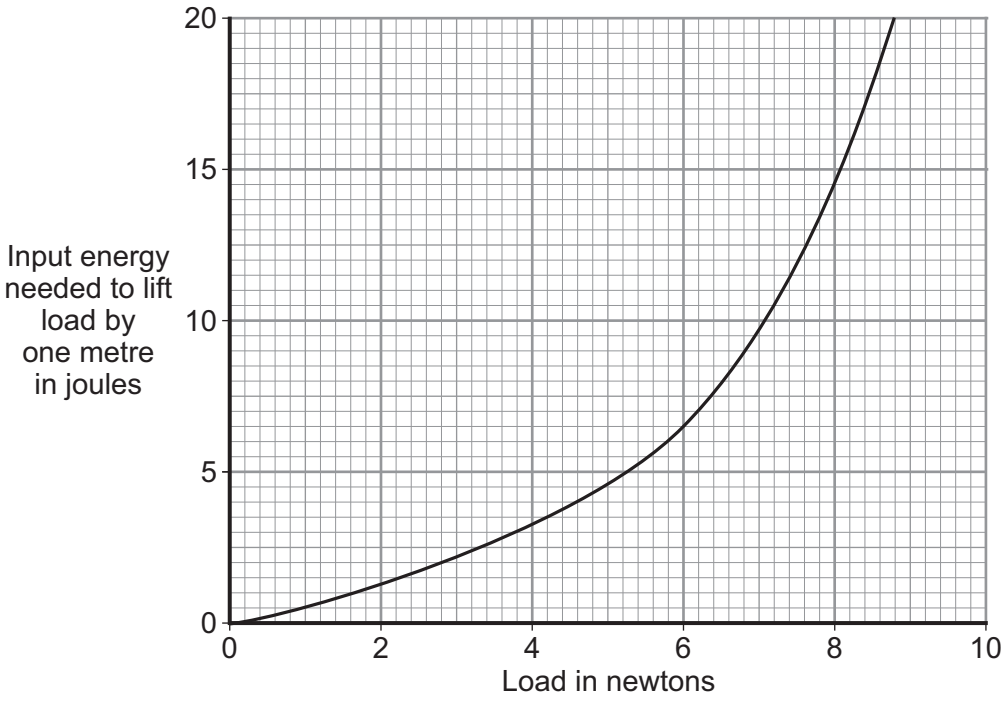
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(1 mark)

Question 2 continues on the next page

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2 (b) The graph shows the input energy the motor needs to lift different loads by one metre.



What can you conclude from the graph about the relationship between the load lifted and the input energy needed?

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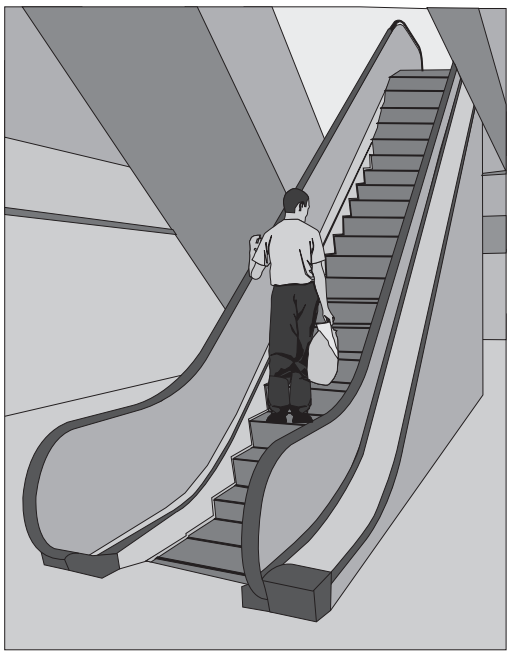
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(2 marks)

Do not write outside the box

2 (c) A shop uses escalators to lift customers to different floor levels. The escalators use electric motors. When the shop is not busy some escalators are turned off.
A sign tells the customers that the escalators are turned off to save energy.



2 (c) (i) Each escalator has one motor with an average power of 4000 W. The motor is turned on for an average of 8 hours each day, 6 days each week. Electricity costs 15 pence per kilowatt-hour.

Calculate the cost of the electricity used in an average week to run **one** escalator.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

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Cost = ... pence
(3 marks)

2 (c) (ii) Give **one** environmental advantage to turning off electrical appliances when they are not being used.

.....

.....
(1 mark)

8

Do not write outside the box

3 (a) Geothermal energy and the energy of falling water are two resources used to generate electricity.

3 (a) (i) What is geothermal energy?

.....

.....

(1 mark)

3 (a) (ii) Hydroelectric systems generate electricity using the energy of falling water.

A pumped storage hydroelectric system can also be used as a way of storing energy for future use.

Explain how.

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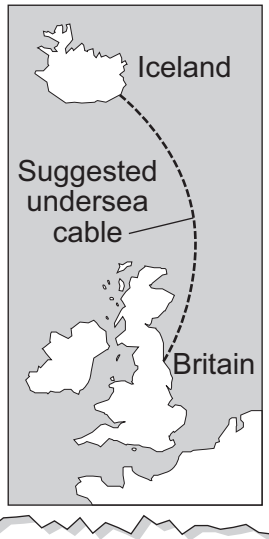
(2 marks)

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

Read the following extract from a newspaper.

Britain may be switched on by Iceland

Iceland is the only country in the world generating all of its electricity from a combination of geothermal and hydroelectric power stations. However, Iceland is using only a small fraction of its energy resources. It is estimated that using only these resources, the amount of electricity generated could be increased by up to four times.



To help supply the future demand for electricity in Britain, there are plans to build thousands of new offshore wind turbines. It has also been suggested that the National Grid in Britain could be linked to the electricity generating systems in Iceland. This would involve laying a 700 mile undersea electricity cable between Iceland and Britain.

Do not write outside the box

Discuss the advantages and disadvantages of the plan to build thousands of offshore wind turbines around Britain **and** the suggested electricity power link between Britain and Iceland.

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(6 marks)

9

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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4 Warm air inside a house contains water in the form of a gas. The water condenses onto cold surfaces such as windows. This leaves liquid water on the inside of the glass.

4 (a) Explain what happens to the particles when water changes from a gas to a liquid.

.....

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(2 marks)

4 (b) Many houses in the UK have double-glazed windows.

Section through double-glazed window



U-value = 2.8 W/m^2 °C

Section through single-glazed window



U-value = 5.0 W/m^2 °C

If the window is double-glazed rather than single-glazed there is less condensation on the inside of the glass.

Explain why.

.....

.....

.....

.....

(2 marks)

Question 4 continues on the next page

Turn over ▶

Do not write outside the box

4 (c) Double glazing can be made using two pieces of normal glass with an air gap between them. Better insulating glass (Superglaze or G-type) can be used instead of normal glass. The size of the air gap can also be increased to improve insulation.

A company making double glazing provides some information about their products.

U-values for different types of double glazing

	Normal glass	Superglaze	G-type
6 mm air gap	3.1	2.7	2.6
12 mm air gap	2.8	2.2	2.0
16 mm air gap	2.7	2.0	1.8

For the same size window, under the same temperature conditions, the energy loss halves if the U-value is halved.

Cost of double glazing in £ per m^2

	Normal glass	Superglaze	G-type
6 mm air gap	90	110	160
12 mm air gap	100	130	185
16 mm air gap	110	155	210

Do not write outside the box

4 (c) (i) The data the double glazing company produced is checked and confirmed independently by other scientists.

Suggest why it is important to confirm the data independently.

.....

.....

(1 mark)

4 (c) (ii) A homeowner is going to replace his old single-glazed windows with new double-glazed windows.

Discuss the cost of fitting double glazing using better insulating glass compared with double glazing using normal glass.

Use the information given in the tables.

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(3 marks)

8

Turn over for the next question

Do not write outside the box

5 Radio waves and microwaves are two types of electromagnetic wave.

Both waves:

- can be used for communications
- travel at the same speed through air.

5 (a) Give **two** more properties that are the same for both radio waves and microwaves.

1 .....

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2 .....

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(2 marks)

5 (b) Some satellites are used to transmit television programmes. Signals are sent to, and transmitted from, the satellites using microwaves.

What is the property of microwaves that allows them to be used for satellite communications?

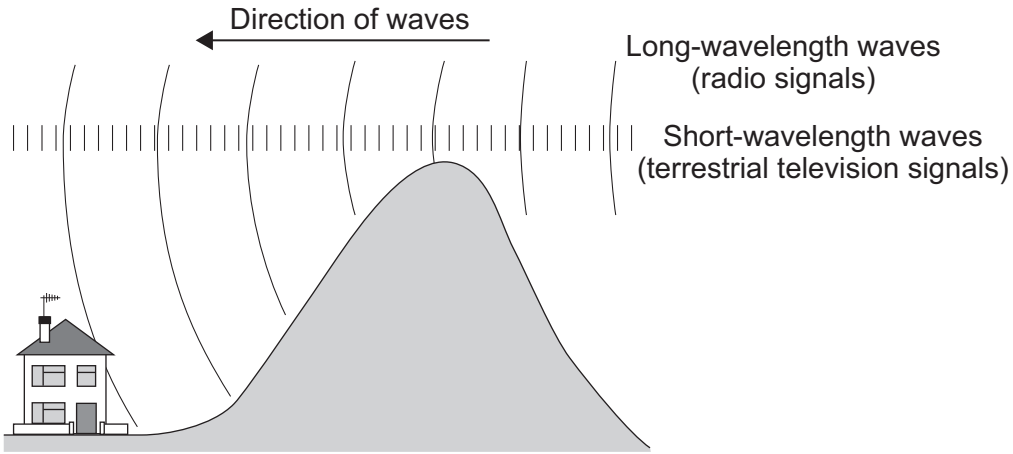
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(1 mark)

5 (c) Terrestrial television does not use satellites.

Terrestrial television signals and radio signals both use radio waves.
Radio signals are transmitted at a longer wavelength than terrestrial television signals.



Do not write outside the box

In hilly areas it may be possible to receive radio signals but not receive terrestrial television signals.

Explain why.

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(3 marks)

5 (d) Electromagnetic waves travel at a speed of 3.0×10^8 m/s.
A radio station transmits waves with a wavelength of 2.5×10^2 m.

Calculate the frequency of the radio waves.

Use the correct equation from the Physics Equations Sheet.

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

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Frequency = ...

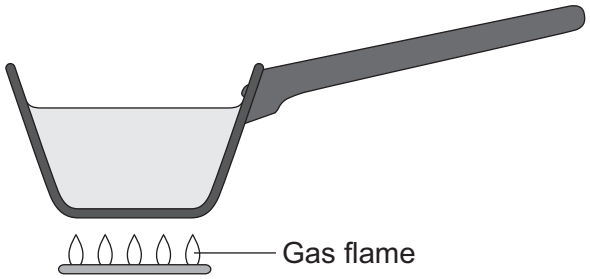
(3 marks)

9

Turn over for the next question

Do not write outside the box

6 The diagram shows a metal pan being used to heat water.



Energy from the gas flame is transferred through the metal pan by conduction.

Explain the process of conduction through metals.

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(4 marks)

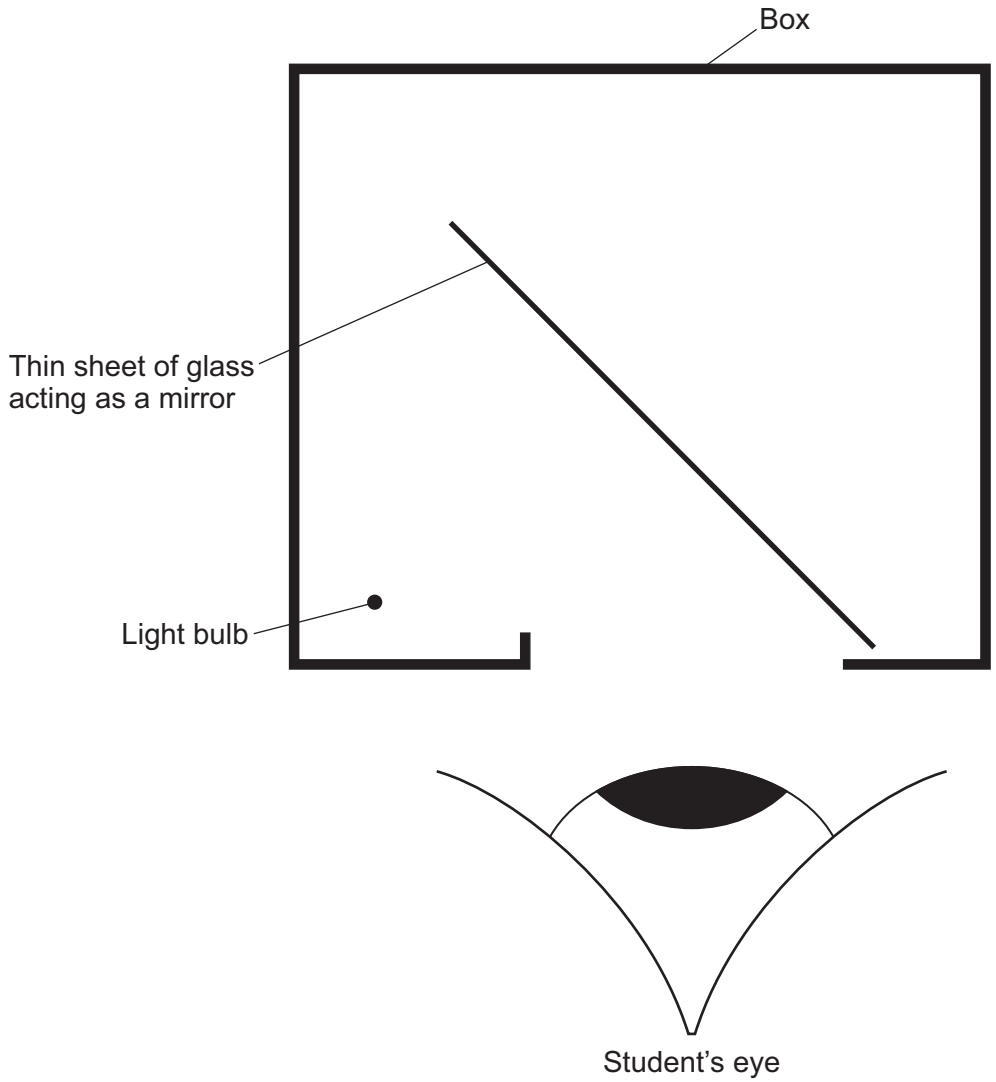
4

Do not write outside the box

7 The diagram shows a model used to demonstrate an illusion known as 'Pepper's Ghost'.

A small light bulb and thin sheet of glass are put inside a box. The thin sheet of glass acts as a mirror. Although the light bulb is switched on, a student looking into the box cannot see the bulb. What the student does see is a virtual image of the bulb.

View from above



7 (a) Use a ruler to complete a ray diagram to show how the image of the light bulb is formed. Mark and label the position of the image.

(4 marks)

7 (b) The image seen by the student is virtual.

Why?

.....

.....

(1 mark)

5

Turn over ▶

Do not write outside the box

8 (a) The 'Big Bang' theory uses red-shift as evidence to explain the beginning of the Universe.

How does the red-shift from distant galaxies provide evidence for the beginning of the Universe?

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(3 marks)

8 (b) Cosmic microwave background radiation (CMBR) is a type of electromagnetic radiation. CMBR fills the Universe. It was first discovered in 1965 by two astronomers called Penzias and Wilson.

8 (b) (i) What do scientists believe is the origin of CMBR?

.....

.....

(1 mark)

8 (b) (ii) Why was the discovery of CMBR so important to the scientists believing the 'Big Bang' theory to be correct?

.....

.....

(1 mark)

8 (b) (iii) How is the wavelength of CMBR likely to change, if at all, over the next billion years?

.....

Give a reason for your answer.

.....

.....

(2 marks)

7

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED

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General Certificate of Secondary Education

Science A 4405 / Physics 4403

PH1HP Unit Physics 1

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.

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

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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.

PH1HP

Question 1

question	answers	extra information	mark
1(a)	any **two** from: • black is a good emitter of (infrared radiation) • large surface (area) • matt surfaces are better emitters (than shiny surfaces)	accept heat for radiation ignore reference to absorbing radiation accept matt surfaces are good emitters ignore reference to good conductor	2
1(b)	90 % or 0.9(0)	efficiency = useful energy out / total energy in (×100%) allow **1** mark for correct substitution ie 13.5 / 15 provided no subsequent step shown an answer of 90 scores **1** mark an answer of 90 / 0.90 with a unit scores **1** mark	2
1(c)	(producing) light	allow (producing) sound	1

Question 1 continues on the next page

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PH1HP

Question 1 continued

question	answers	extra information	mark
1(d)	any **two** from: • wood is renewable • (using wood) conserves fossil fuels • wood is carbon neutral	 accept wood grows again / quickly accept wood can be replanted accept doesn't use fossil fuels accept a description cheaper / saves money is insufficient	2
1(e)	 2 550 000 joules /J	$E = m \times c \times \theta$ allow **1** mark for correct substitution ie 100 × 510 x 50 provided no subsequent step shown answers of 1 020 000, 3 570 000 gain **1** mark accept kJ / MJ do **not** accept j for full credit the unit and numerical answer must be consistent	 2 1
Total			**10**

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PH1HP

Question 2

question	answers	extra information	mark
2(a)(i)	kinetic (energy)	allow gravitational potential (energy) / gpe movement is insufficient	1
2(a)(ii)	dissipates into the surroundings	allow warms up the surroundings / air / motor accept lost to the surroundings accept lost as heat ignore reference to sound it is lost is insufficient	1
2(b)	energy (required) increases with load further amplification eg increases slowly at first (or up to 4 / 5 N), then increases rapidly	accept positive correlation do **not** accept (directly) proportional simply quoting figures is insufficient an answer that only describes the shape of the line gains **no** marks	1 1

Question 2 continues on the next page

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PH1HP

Question 2 continued

question	answers	extra information	mark
2(c)(i)	2880	$E = P \times t$ accept £28.80 for all **3** marks an answer £2880 gains **2** marks allow **1** mark for obtaining 48 h **or** converting to kW allow **2** marks for correct substitution ie $4 \times 48 \times 15$ note: this substitution may be shown as two steps an answer 2 880 000 gains **2** marks an answer £4.80 / 480 gains **2** marks an answer of 192 (ie calculation of energy without subsequent calculation of cost) gains **1** mark)	3
2(c)(ii)	any sensible suggestion eg conserves fossil fuels less (fossil) fuels burned less pollutant gas (produced) less greenhouse gas (produced)	accept a named pollutant gas saves energy is insufficient	1
Total			**8**

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PH1HP

Question 3

question	answers	extra information	mark
3(a)(i)	energy from hot rocks in the Earth	accept heat that occurs naturally in the Earth accept steam / hot water rising to the Earth's surface accept an answer in terms of the energy released by radioactive decay in the Earth heat energy is insufficient	1
3(a)(ii)	water is pumped / moved up (to a higher reservoir)	 this mark point only scores if first mark point is awarded	1 1
3(b)			6

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

0 marks	Level 1 (1-2 marks)	Level 2 (3-4 marks)	Level 3 (5-6 marks)
No relevant content	There is a brief description of at least one advantage or disadvantage for either the planned wind turbines or the suggested electricity power link.	There is a description of advantages and disadvantages for either the planned wind turbines or the suggested electricity power link. **or** A description of the advantages or disadvantages for both the planned wind turbines and the suggested electricity power link.	There is a clear and detailed description of at least one advantage and one disadvantage for both the planned wind turbines and suggested electricity power link.

Question 3 continues on the next page

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PH1HP

Question 3 continued

examples of the points made in the response	extra information
Offshore wind turbines	
advantages	
• renewable (energy resource)	
• low running costs	
• energy is free	
• no gas emissions (when in use)	accept a named gas eg CO_2 accept no fuel is burned accept less dependent on fossil fuels
• land is not used (up)	
disadvantages	
• unreliable – accept wind does not always blow	ignore references to destroying or harming habitats
• hazard to birds / bats	
• visual pollution – do not accept noise pollution	do **not** allow if clearly referring to onshore wind turbines
• difficulty of linking turbines to the National Grid	do **not** accept spoils landscape
• large initial cost	
• difficult to erect / maintain	accept a lot of maintenance needed
• CO_2 emissions in manufacture (of large number of turbines)	

Question 3 continues on the next page

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PH1HP

Question 3 continued

examples of the points made in the response	extra information
Suggested Link	
advantages	
• income for Iceland	
• using Iceland's (available) energy (resources)	accept using (Iceland's) renewable energy (resources) do **not** accept reduce the amount of Iceland's wasted energy
• provide electricity when wind does not blow / reliable	
• provide electricity at times of peak demand	
• even out fluctuations in supply	
• excess electricity from Britain (windy days) to Iceland and used to pump water up to store energy	
• Britain less dependent on fossil fuels	accept Britain needs fewer (new) power stations accept conserves fossil fuels
disadvantages	
• large initial cost	accept expensive (to lay cables)
• power loss along a long cable	
• (engineering) difficulties in laying / maintaining the cable	accept difficult to repair (if damaged)

Total			**9**

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Question 4

question	answers	extra information	mark
4(a)	(kinetic) energy (of the particles) is reduced move closer together	accept slow down accept transfer energy to (cold) glass / surface accept energy is lost do **not** accept vibrate less	1 1
4(b)	double glazing provides (better) insulation (inside of) glass is not as cold	accept double glazing has a lower U-value accept less energy / heat transfer through double glazing accept window stays warm(er)	1 1
4(c)(i)	any **one** from: • to avoid bias • to make sure results are reproducible	 accept repeatable / reliable for reproducible	1
4(c)(ii)	any **three** from: • the lower the U-value, the better the insulator • better insulating glass costs more money • increasing the (width of) air gap increases cost • additional cost of better insulating glass offset by energy savings	accept Superglaze or G-type for 'better insulating glass' throughout 'better insulating glass' has a lower U-value is insufficient	3
Total			**8**

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Question 5

question	answers	extra information	mark
5(a)	any **two** from: • travel (at same speed) through a vacuum / space • transverse • transfer energy • can be reflected • can be refracted • can be diffracted • can be absorbed • travel in straight lines	do **not** accept air for vacuum	2
5(b)	can pass through the ionosphere	accept atmosphere for ionosphere do **not** accept air for ionosphere accept travel in straight lines accept not refracted / reflected / absorbed by the ionosphere	1
5(c)	diffraction (of waves around hills) wavelength needs to be similar size to the obstacle / gap radio has a long enough wavelength **or** TV doesn't have a long enough wavelength	an answer TV (waves / signals) have short wavelengths so do not diffract (around the hill) scores **2** marks	1 1 1

Question 5 continues on the next page

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PH1HP

Question 5 continued

question	answers	extra information	mark
5(d)		$v = f \times \lambda$	
	1.2×10^6 / 1200 000	allow **1** mark for correct substitution ie $3.0 \times 10^8 = f \times 2.5 \times 10^2$	2
	hertz / Hz	do **not** accept hz **or** HZ	1
		accept kHz **or** MHz	
		answers 1.2 MHz **or** 1200 kHz gain all **3** marks	
		for full credit the unit and numerical value must be consistent	
Total			**9**

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PH1HP

Question 6

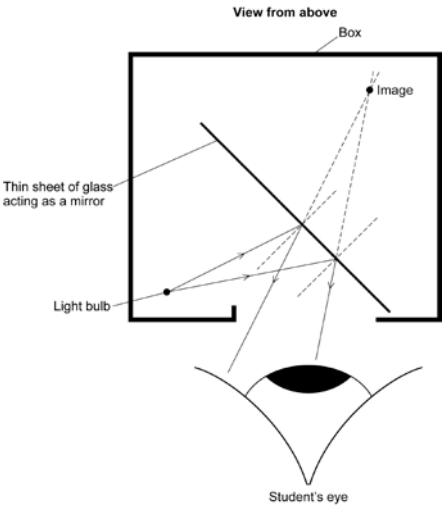
question	answers	extra information	mark
6		accept atoms / particles for ions throughout	
	(a metal has) free <u>electrons</u>	accept mobile for free	1
	(kinetic) energy of (free) electrons increases	accept energy of ions increases accept ions vibrate with a bigger amplitude accept ions vibrate more do **not** accept electrons vibrate more	1
	(free) <u>electrons</u> move faster **or** electrons move through metal	accept electrons collide with other electrons / ions	1
	(so) electrons transfer energy to other electrons / ions	accept ions transfer energy to neighbouring ions	1
Total			**4**

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Question 7

question	answers	extra information	mark
7(a)	two rays drawn from the bulb and reflected by the glass	angle **I** = angle **R** judged by eye allow **1** mark for one incident and reflected ray even if angle **I** doesn't equal angle **R**	2
	at least one arrow drawn in correct direction	any conflicting arrows negate this mark ignore any arrows drawn on construction lines behind the glass	1
	position of image correct	judged by eye	1



Question 7 continues on the next page

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PH1HP

Question 7 continued

question	answers	extra information	mark
7(b)	image is formed by virtual / imaginary rays crossing	accept construction lines only show where the light seems to come from accept the image is behind the glass / mirror accept image is seen through the glass / mirror accept (real) rays of light do not pass through the image accept (real) rays do not cross accept the image is a reflection (of the object) accept the image is formed by reflection do **not** accept a virtual image can't be formed on a screen do **not** accept the object / image is reflected	1
Total			**5**

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Question 8

question	answers	extra information	mark
8(a)	any **three** from: • red-shift shows galaxies are moving away (from each other / the Earth) • more distant galaxies show bigger red-shift **or** more distant galaxies show a greater increase in wavelength • (in all directions) more distant galaxies are moving away faster • suggests single point of origin (of the universe)	accept correct reference to frequency in place of wavelength accept (suggests) universe is expanding	3
8(b)(i)	(radiation produced shortly after) 'Big Bang'	accept beginning of time / beginning of the universe for 'Big Bang'	1
8(b)(ii)	any **one** from: • can only be explained by 'Big Bang' • existence predicted by 'Big Bang' • provides (further) evidence for 'Big Bang'	ignore proves 'Big Bang' (theory) ignore reference to red-shift	1

Question 8 continues on the next page

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PH1HP

Question 8 continued

question	answers	extra information	mark
8(b)(iii)	increase universe continues to accelerate outwards **or** greater red-shift	accept becomes radio waves accept as universe continues to expand	1 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	
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4	
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6	
7	
8	
TOTAL	

General Certificate of Secondary Education
Higher Tier
January 2012

Science A
Unit Physics P1

PH1HP

H

Physics
Unit Physics P1

Friday 20 January 2012 9.00 am to 10.00 am

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

You may use a calculator.

Time allowed
- 1 hour

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

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

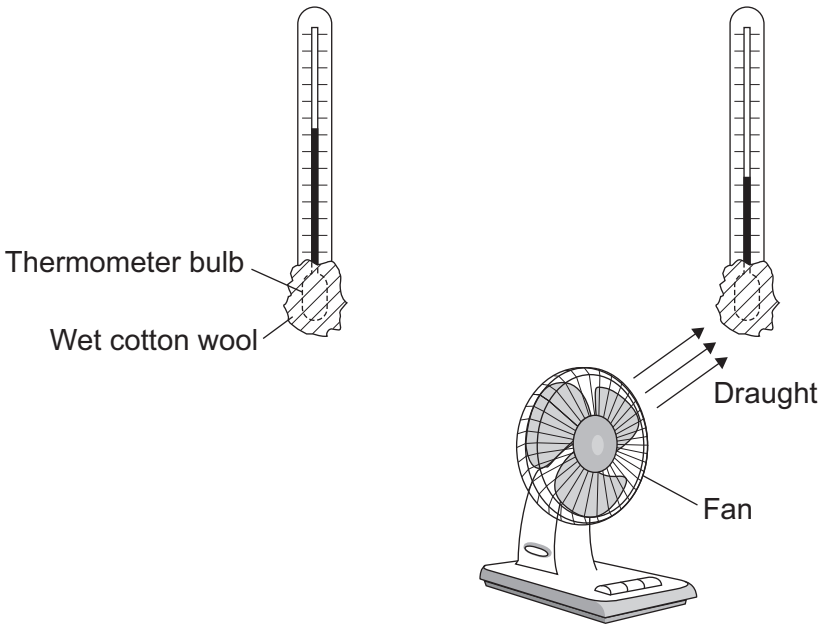
Advice
- In all calculations, show clearly how you work out your answer.

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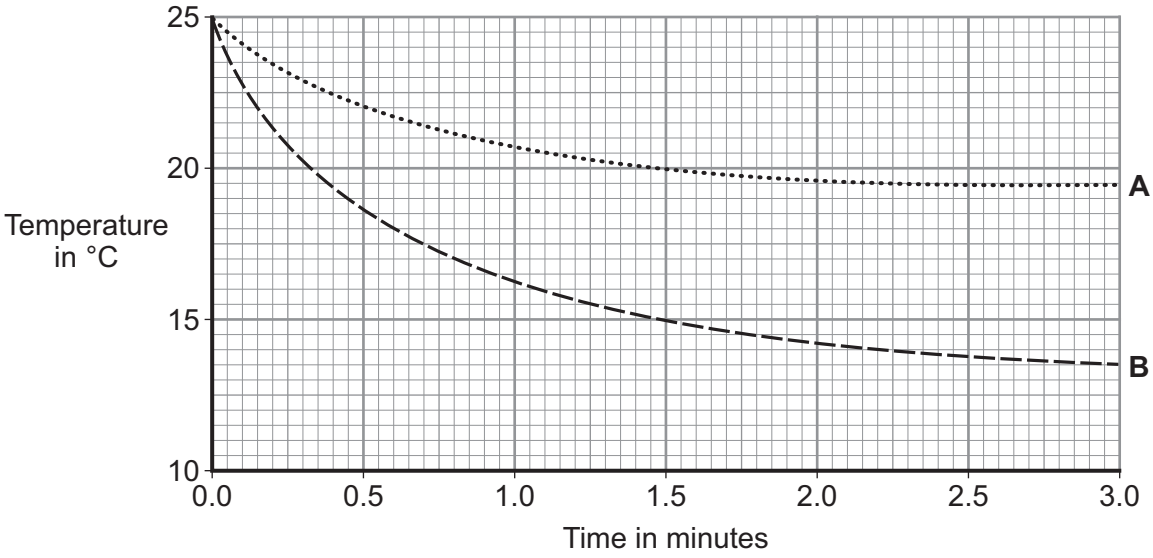
Do not write outside the box

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

1 The diagram shows two thermometers. The bulb of each thermometer is covered with a piece of wet cotton wool. One of the thermometers is placed in the draught from a fan.



The graph shows how the temperature of each thermometer changes with time.



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Do not write outside the box

1 (a) Which of the graph lines, **A** or **B**, shows the temperature of the thermometer placed in the draught?

Write the correct answer in the box. ☐

Explain, in terms of evaporation, the reason for your answer.

.....

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(3 marks)

1 (b) A wet towel spread out and hung outside on a day without wind dries faster than an identical wet towel left rolled up in a plastic bag.

Explain why.

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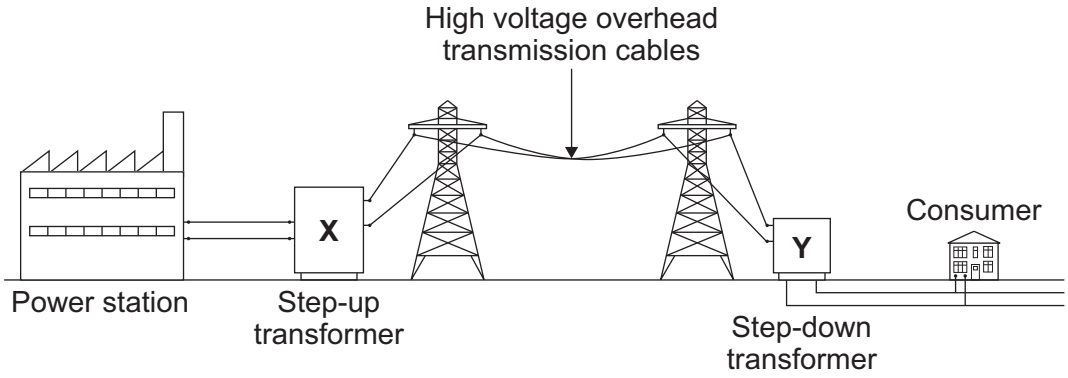
(2 marks)

5

Turn over for the next question

Do not write outside the box

2 The diagram shows the National Grid system.



2 (a) The National Grid includes step-up transformers.

Explain why.

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(2 marks)

Do not write outside the box

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

Over the next 10 years, more than 300 kilometres of new high voltage transmission cables are to be added to the National Grid. Most of the new cables will be suspended from pylons and run overhead while the rest will be buried underground.

Outline the advantages and disadvantages of both overhead transmission cables and underground transmission cables.

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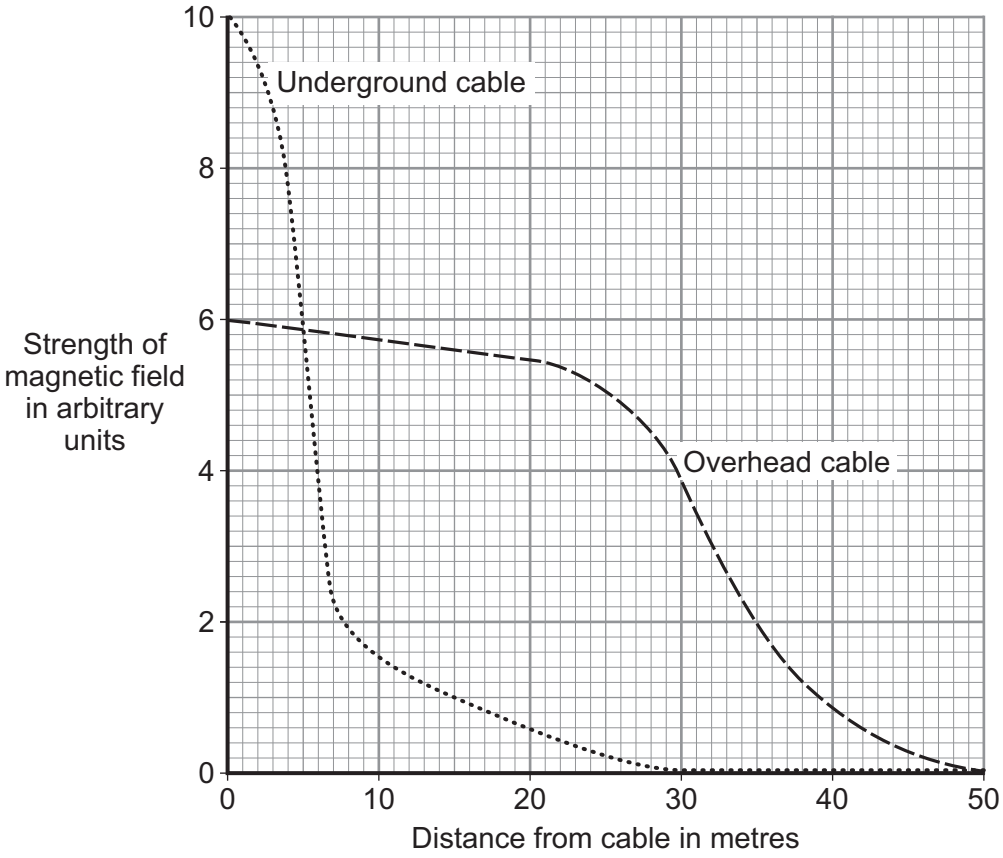
(6 marks)

Question 2 continues on the next page

Do not write outside the box

2 (c) When an electric current flows through a transmission cable, a magnetic field is produced.

The graph shows how the strength of the magnetic field varies with distance from both overhead and underground transmission cables that carry the same current.



What conclusions may be drawn from this graph?

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.....

.....

(2 marks)

Do not write outside the box

2 (d) Some people think that, because of the magnetic fields, living close to transmission cables is dangerous to health. Laboratory studies on mice and rats exposed to magnetic fields for two or more years found that the magnetic fields had no effect on the animals' health.

Draw a ring around the correct answer in the box to complete the sentence.

Using animals in scientific research raises | economic / environmental / ethical | issues.

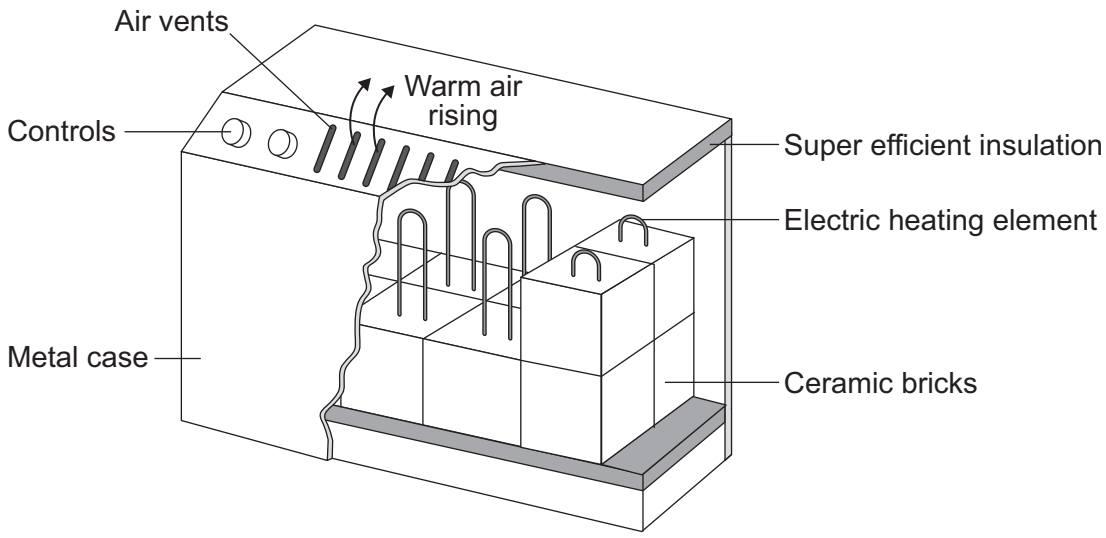
(1 mark)

11

Turn over for the next question

Do not write outside the box

3 The diagram shows how one type of electric storage heater is constructed. The heater has ceramic bricks inside. The electric elements heat the ceramic bricks during the night. Later, during the daytime, the ceramic bricks transfer the stored energy to the room.



3 (a) In winter, the electricity supply to a 2.6 kW storage heater is switched on each day between midnight and 7 am. Between these hours, electricity costs 5 p per kilowatt-hour.

Calculate the daily cost of using the storage heater.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

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Cost = ... p

(3 marks)

Do not write outside the box

3 (b) Homes with electric storage heaters have a separate meter to measure the electricity supplied between midnight and 7 am. Another meter measures the electricity supplied at other times. This electricity supplied at other times costs 15 p per kilowatt-hour.

Electricity companies encourage people to use electricity between midnight and 7 am by selling the electricity at a lower cost.

Suggest why.

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.....

(1 mark)

3 (c) By 7 am, the temperature at the centre of the ceramic bricks is about 800 °C. The temperature of the outside metal casing is about 80 °C.

The ceramic bricks are surrounded by 'super-efficient' insulation.

Explain why.

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(2 marks)

3 (d) At 7 am, the electricity supply switches off and the temperature of the ceramic bricks starts to fall. The temperature of the bricks falls by 100 °C over the next four hours. During this time, 9 000 000 J of energy are transferred from the bricks.

Calculate the total mass of ceramic bricks inside the heater.

Specific heat capacity of the ceramic bricks = 750 J/kg °C.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

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.....

Mass = ... kg

(2 marks)

8

Turn over ▶

Do not write outside the box

4 (a) Water waves are transverse waves. Sound waves are longitudinal waves.

4 (a) (i) Explain the difference between a transverse wave and a longitudinal wave.

You may include labelled diagrams in your answer.

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(3 marks)

4 (a) (ii) Name **one** type of wave that may be either transverse or longitudinal.

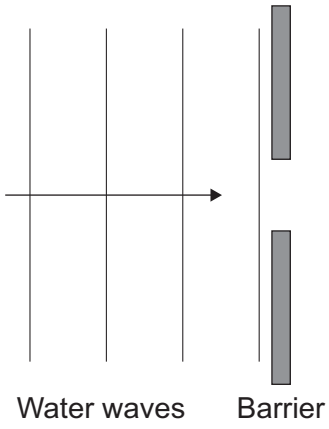
.....

(1 mark)

4 (b) The diagram shows water waves in a ripple tank moving towards a gap in a barrier.

The water waves diffract as they pass through the gap.

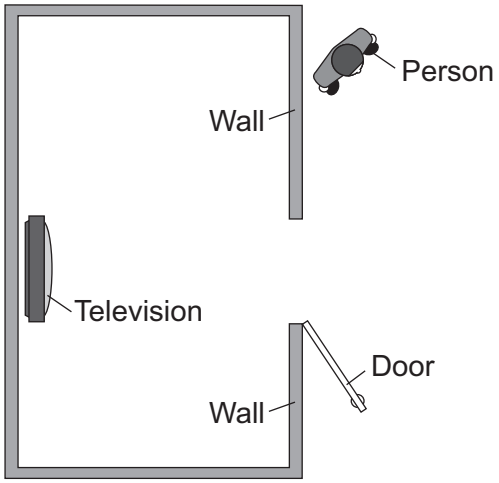
Complete the diagram to show the diffracted water waves.



(1 mark)

Do not write outside the box

4 (c) A television is switched on inside a room. A person outside the room can hear the television, but only when the door is open.



When the door is open, the person can hear the sound but cannot see the television.

Explain why.

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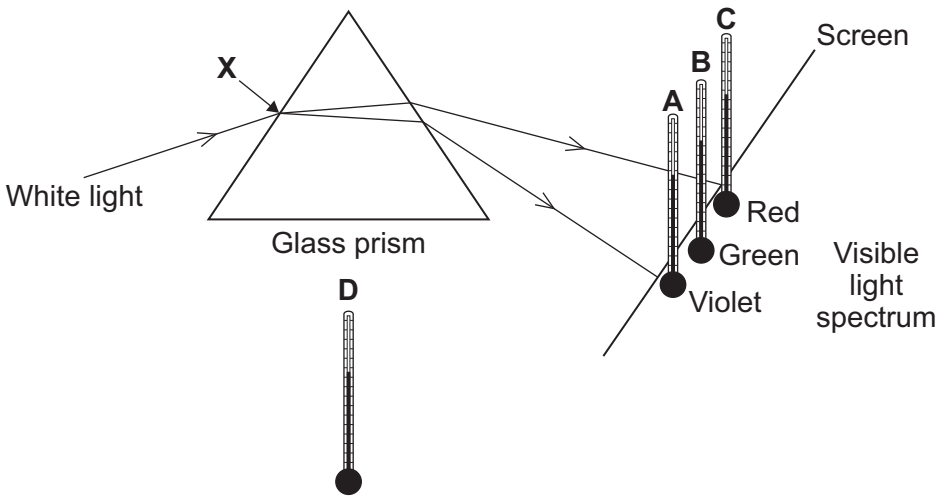
(2 marks)

7

Turn over for the next question

Do not write outside the box

5 The diagram shows the apparatus that a student used to investigate the heating effect of different wavelengths of light.



5 (a) (i) What process happens at the point labelled **X** on the diagram?

.....

(1 mark)

5 (a) (ii) The student put thermometer **D** outside of the light spectrum.

Suggest why.

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.....

(1 mark)

Do not write outside the box

5 (a) (iii) The table gives the position and reading of each thermometer 10 minutes after the investigation started.

Thermometer	Position of thermometer	Temperature in °C
A	in violet light	21
B	in green light	22
C	in red light	24
D	outside the spectrum	20

What should the student conclude from the data in the table?

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(2 marks)

5 (b) A similar investigation completed in 1800 by the scientist Sir William Herschel led to the discovery of infrared radiation.

Suggest how the student could show that the spectrum produced by the glass prism has an infrared region.

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(2 marks)

Question 5 continues on the next page

Do not write outside the box

5 (c) A person emits infrared radiation at a frequency of 3.2×10^{13} Hz.

Calculate the wavelength of the infrared radiation that a person emits.

Take the speed of infrared radiation to be 3.0×10^{8} m/s.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

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Wavelength = ... m

(2 marks)

5 (d) A thermal imaging camera detects infrared radiation. Electronic circuits inside the camera produce a visible image of the object emitting the infrared radiation.

At night, police officers use thermal imaging cameras to track criminals running away from crime scenes.

Thermal imaging cameras work better at night than during the day.

Explain why.

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(2 marks)

10

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

6 The table gives data about two types of low energy bulb.

Type of bulb	Power input in watts	Efficiency	Lifetime in hours	Cost of one bulb
Compact Fluorescent Lamp (CFL)	8	20 %	10 000	£3.10
Light Emitting Diode (LED)	5		50 000	£29.85

6 (a) Both types of bulb produce the same useful power output.

6 (a) (i) Calculate the useful power output of the CFL.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

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Useful power output = ... W

(2 marks)

6 (a) (ii) Calculate the efficiency of the LED bulb.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

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Efficiency = ...

(1 mark)

Do not write outside the box

6 (b) Sketch and label a Sankey diagram for the CFL.

(2 marks)

6 (c) LED bulbs are expensive. This is because of the large number of individual electronic LED chips needed to produce sufficient light from each bulb.

6 (c) (i) Use the data in the table to evaluate the cost-effectiveness of an LED bulb compared to a CFL.

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(2 marks)

6 (c) (ii) Scientists are developing brighter and more efficient LED chips than those currently used in LED bulbs.

Suggest **one** benefit of developing brighter and more efficient LED chips.

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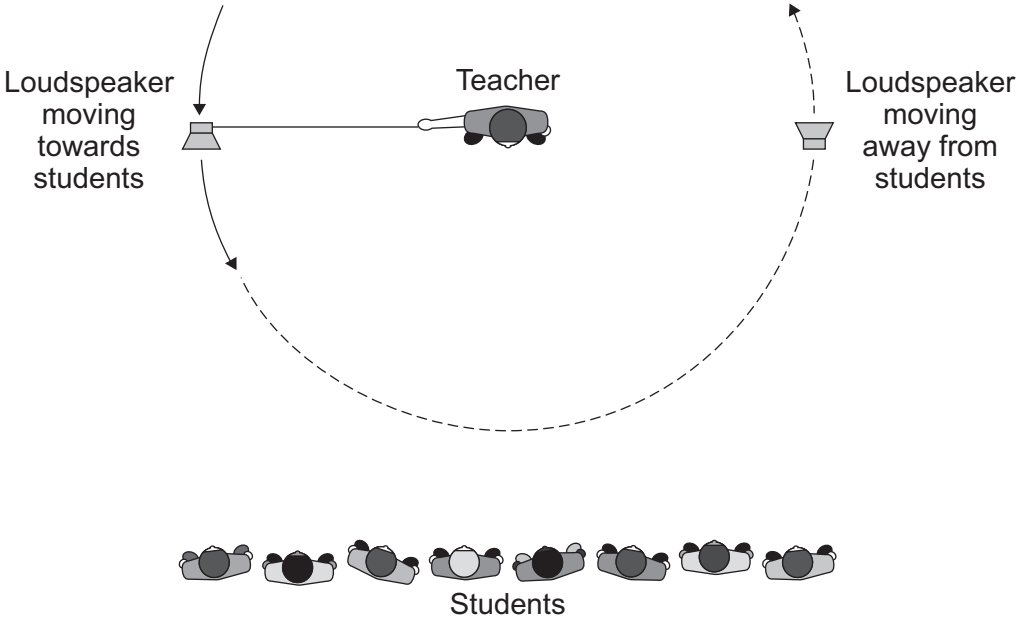
(1 mark)

8

Turn over ▶

Do not write outside the box

7 The diagram shows a teacher using a loudspeaker to demonstrate the Doppler effect. The loudspeaker, which produces a note of constant frequency, is swung around in a circle.



7 (a) What is the Doppler effect?

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.....

(2 marks)

Do not write outside the box

7 (b) This demonstration of the Doppler effect can be used as a model for the *red-shift* observed in the light spectra from distant galaxies.

What is red-shift and what does the size of the red-shift tell us about distant galaxies?

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(3 marks)

5

Turn over for the next question

Do not write outside the box

8 (a) Nuclear fuels and the wind are two of the energy sources used to generate electricity in the UK.

Explain the advantages of using energy from nuclear fuels to generate electricity rather than using energy from the wind.

Include in your answer a brief description of the process used to generate electricity from nuclear fuels.

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(4 marks)

8 (b) In the UK, most electricity is generated in power stations that emit carbon dioxide into the atmosphere. The impact of these power stations on the environment could be reduced by the increased use of 'carbon capture' technology.

Describe how 'carbon capture' would prevent the build-up of carbon dioxide in the atmosphere.

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(2 marks)

6

END OF QUESTIONS

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Version1.0: 29/02/2012

General Certificate of Secondary Education

Science A 4405 / Physics 4403

PH1HP Unit Physics P1

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.

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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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Quality of Written Communication and levels marking

In Question 2(b) 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.

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Question 1

question	answers	extra information	mark
1(a) E	**B**	no mark for **B** - marks are for the explanation first two mark points can score even if **A** is chosen	
	draught increases (the rate of) evaporation	accept more evaporation happens accept draught removes (evaporated) particles faster do **not** accept answers in terms of particles gaining energy from the fan / draught	1
	evaporation has a cooling effect	accept (average) kinetic energy of (remaining) particles decreases	1
	so temperature will fall faster / further		1
1(b) E	larger surface area		1
	increasing the (rate of) evaporation **or** for water to evaporate from	accept more / faster evaporation accept easier for particles to evaporate accept more particles can evaporate accept water / particles which have evaporated are trapped (in the bag) answers in terms of exposure to the Sun are insufficient	1
Total			**5**

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Question 2

question	answers	extra information	mark
2(a) E	increases the voltage (across the cables) **or** decreases the current (through the cables)		1
	reducing energy losses (in cables) **or** increases efficiency of (electricity / energy) transmission	accept heat for energy do **not** accept electricity for energy do **not** accept no energy loss accept wires do not get as hot ignore reference to travel faster	1

2(b) E			6
Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 4, and apply a 'best-fit' approach to the marking.			
0 marks	**Level 1 (1–2 marks)**	**Level 2 (3–4 marks)**	**Level 3 (5–6 marks)**
No relevant content	There is a brief description of one advantage or disadvantage of using either overhead or underground cables.	There is a description of some of the advantages **and / or** disadvantages for both overhead and underground cables, with a minimum of three points made. There must be at least **one** point for each type of cable.	There is a clear and detailed description of the advantages **and** disadvantages of overhead and underground cables, with a minimum of five points made. At least one advantage and one disadvantage for each type of cable.

Question 2 continues on the next page . . .

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Question 2 continued . . .

question	answers	extra information	mark
examples of the points made in the response Overhead Advantages: • (relatively) quick / easy to repair / maintain / access • less expensive to install / repair / maintain • cables cooled by the air • air acts as <u>electrical</u> insulator • can use thinner cables Disadvantages: • spoil the landscape • greater risk of (fatal) electric shock • damaged / affected by (severe) weather • hazard to low flying aircraft / helicopters		**extra information** marks may be gained by linking an advantage for one type of cable with a disadvantage for the other type of cable eg eg overhead cables are easy to repair = 1 mark overhead cables are easier to repair = 1 mark overhead cables are easier to repair than underground cables = 2 marks easy to install is insufficient do **not** accept easy to spot / see a fault less expensive is insufficient accept thermal energy / heat removed by the air accept there is no need for electrical insulation (around the cables) difficult to reach is insufficient land beneath cables can still be used is insufficient accept specific examples eg high winds, ice more maintenance is insufficient kites / fishing lines can touch them is insufficient hazard to aircraft is insufficient	

Question 2 continues on the next page . . .

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Question 2 continued . . .

question	answers	extra information	mark
	Underground Advantages: • cannot be seen • no hazard to aircraft / helicopters • unlikely to be / not damaged / affected by (severe) weather (normally) no / reduced shock hazard Disadvantages: • repairs take longer / are more expensive • (more) difficult to access (cables) • (very) expensive to install • thicker cables required • need cooling systems • need layers of <u>electrical</u> insulation • land disruption (to lay cables) **or** cannot use land either side of cable path	less maintenance is insufficient installed in urban areas is insufficient accept harder to repair / maintain have to dig up for repairs is insufficient hard to locate (cables) is insufficient faults hard to find is insufficient accept damage to environment / habitat(s) accept restricted land use	

Question 2 continues on the next page . . .

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Question 2 continued . . .

question	answers	extra information	mark
2(c) E	examples of acceptable responses: • closest to cables field from underground is stronger • field from overhead cables stronger after 5 metres • field from underground cables drops rapidly • field from overhead cables does not drop much until after 20 metres • overhead field drops to zero at / after 50 metres • underground field drops to zero at / after 30 metres • (strength of) field decreases with distance for <u>both</u> types of cable	allow **1** mark for each correct point accept values between 20 and 30 inclusive if suitably amplified this may score both marks	2
2(d) A	ethical		1
Total			**11**

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Question 3

question	answers	extra information	mark
3(a) E	91 (p)	$E = P \times t$ an answer £0.91 gains 3 marks an answer 0.91 gains 2 marks allow **2** marks for energy transferred = 18.2 (kWh) **or** substitution into 2 equations combined, ie $2.6 \times 7 \times 5$ allow **1** mark for correct substitution into $E = P \times t$, ie $E = 2.6 \times 7$ **or** allow **1** mark for multiplying and correctly calculating an incorrect energy transfer value by 5	3
3(b) E	answers should be in terms of supply exceeding demand	accept there is a surplus / excess of electricity (at night)	1
3(c) E	reduce (rate of) energy transfer (from ceramic bricks)	accept heat for energy do **not** accept no energy / heat escapes do **not** accept answers in terms of lost / losing heat if this implies heat is wasted energy	1
	so keeping the (ceramic) bricks hot for longer **or** to stop the casing getting too hot	accept increase time that energy is transferred to the room accept keep room warm for longer accept so you do not get burnt (on the casing)	1

Question 3 continues on the next page . . .

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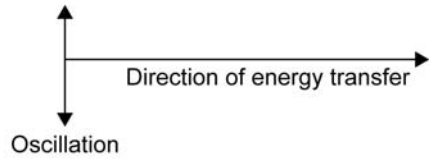
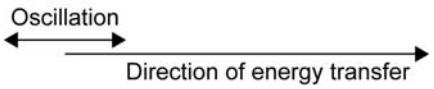
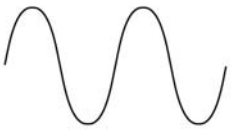
Question 3 continued . . .

question	answers	extra information	mark
3(d) E	120	$E = m \times c \times \theta$ allow **1** mark for correct substitution ie $9\,000\,000 = m \times 750 \times 100$	2
Total			**8**

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Question 4

question	answers	extra information	mark
4(a)(i) E	the oscillation / vibration (causing the wave)	a movement causes the wave is insufficient	1
	for a transverse wave is perpendicular to the direction of <u>energy</u> transfer	answers given in terms of direction of wave travel and not energy transfer for both types of wave, score **1** mark for these **two** mark points	1
	and for a longitudinal wave is parallel to the direction of <u>energy</u> transfer		1
		the marks may be scored by the drawing of two <u>correctly labelled</u> diagrams ie **Transverse**  **Longitudinal**  	
		two labelled diagrams showing the general form of a transverse and longitudinal wave gain **1** mark if no other mark has been awarded eg **Transverse**  **Longitudinal** 	

Question 4 continues on the next page . . .

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Question 4 continued . . .

question	answers	extra information	mark
4(a)(ii) E	mechanical wave	accept specific examples, eg waves on a spring / slinky / seismic / earthquake waves accept water waves do **not** accept shock waves	1
4(b) E	semicircular waves drawn	judged by eye do not need to be full semicircles ignore any rays	1
4(c) E	sound (waves) will <u>diffract</u> (towards the person) **or** light (waves) do not diffract (towards the person) (because) width of door way similar to / less than wavelength of sound (waves) **or** (because) width of doorway much greater than wavelength of light (waves)	a general statement that waves (only) <u>diffract</u> when the width of a gap is similar to the wavelength of the waves can be awarded **1** mark	1 1
Total			**7**

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Question 5

question	answers	extra information	mark
5(a)(i) G	refraction	accept refracted reflection, diffraction and dispersion are incorrect	1
5(a)(ii) E	to check rise in temperature (of other thermometers) was due to the (different wavelengths of) light	accept as a control / comparison to measure room temperature is insufficient	1
5(a)(iii) E	any **two** from three: • different colours produce different heating effects / (rises in) temperatures • red light produces the greatest heating effect / (rise in) temperature **or** • violet produces the least heating effect / (rise in) temperature • all colours produce a greater heating effect than outside the spectrum	an answer the longer the <u>wavelength</u> the greater the (rise in) temperature **or** the lower the <u>frequency</u> the greater the (rise in) temperature gains both marks	2
5(b) E	move a thermometer into the infrared region / just beyond the red light the temperature increases beyond 24(°C)	allow use an infrared camera / infrared sensor accept temperature higher than for the red light	1 1

Question 5 continues on the next page . . .

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Question 5 continued . . .

question	answers	extra information	mark
5(c) E	9.4×10^{-6} **or** 0.0000094	$v = f \times \lambda$ accept 9.375×10^{-6} or 9.38×10^{-6} accept 0.000009375 **or** 0.00000938 allow **1** mark for correct substitution ie $3 \times 10^{8} = 3.2 \times 10^{13} \times \lambda$	2
5(d) E	at night the surroundings are cooler **or** at night there is a greater temperature difference between people and surroundings	accept at night the air is colder there is no heat from the Sun is insufficient	1
	(so surroundings) emit less infrared (than in daytime) **or** gives larger difference in infrared emitted (between people and surroundings)	accept camera detects a greater contrast	1
Total			**10**

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Question 6

question	answers	extra information	mark
6(a)(i) E clip with 6(a)(ii)	1.6 (W)	efficiency = $\frac{\text{useful power out}}{\text{total power in}}$ (×100%) allow **1** mark for correct substitution ie $0.2 / \frac{20}{100} = \frac{\text{output}}{8}$	2
6(a)(ii) E clip with 6(a)(i)	32 (%) / 0.32 **or** their (a)(i) ÷ 5 correctly calculated	efficiency = $\frac{\text{useful power out}}{\text{total power in}}$ (×100%) ignore any units	1
6(b) E	two output arrows narrower arrow labelled light or useful (energy / output / power) **and** wider arrow labelled waste (energy / output / power)	one arrow should be wider - judged by eye only scores if first mark awarded accept heat ignore numerical values	1 1

Question 6 continues on the next page . . .

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Question 6 continued . . .

question	answers	extra information	mark
6(c)(i) E	any **two** from: • comparison over same period of time of relative numbers of bulbs required eg over 50 000 hours 5 CFL's required to 1 LED • link number of bulbs to cost eg 5 CFL's cheaper than 1 LED • over the same period of time LEDs cost less to operate (than CFLs)	accept an LED lasts 5 times longer an answer in terms of over a period of 50 000 hours CFLs cost £15.50 (to buy), LED costs £29.85 (to buy) so CFLs are cheaper scores both marks an answer in terms of the cost per hour (of lifetime) being cheaper for CFL scores 1 mark if then correctly calculated scores both marks	2
6(c)(ii) E	any **one** from: • price of LED bulbs will drop • less electricity needs to be generated • less CO_2 produced • fewer chips needed (for each LED bulb) • fewer bulbs required (for same brightness / light) • less energy wasted	do **not** accept they become cheaper accept we will use less electricity do **not** accept electricity for energy	1
Total			**8**

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Question 7

question	answers	extra information	mark
7(a) E	change in (observed) wavelength / frequency	accept specific change eg increase accept pitch for frequency provided the source is sound	1
	when source of waves / observer moves (relative to each other)	accept specific example of source accept specific example of movement for both marks a specific change in wavelength / frequency must be linked to a correct specific movement of source / observer	1
7(b) E	(observed) increase in wavelength of light (from distant galaxies) **or** (observed) decrease in the frequency of light (from distant galaxies)	accept a correct description eg wavelength(s) of light (from distant galaxies) moves towards red end of spectrum **or** (pattern) of (black) lines in (visible) spectrum move towards red end galaxy looks red negates this first mark point	1
	because the galaxy is moving away from the Earth / us		1
	the bigger the red-shift the faster the galaxy is moving	accept bigger the red-shift the further the galaxy is from the Earth	1
Total			**5**

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Question 8

question	answers	extra information	mark
8(a) E		answers must be in terms of nuclear fuels	
	concentrated source of energy	idea of a small mass of fuel able to generate a lot of electricity	1
	that is able to generate continuously	accept it is reliable **or** can control / increase / decrease electricity generation idea of available all of the time / not dependent on the weather ignore reference to pollutant gases	1
	the energy from (nuclear) <u>fission</u>		1
	is used to heat water to steam to turn turbine linked to a generator		1
8(b) E	<u>carbon dioxide</u> is not released (into the atmosphere)		1
	but is (caught and) stored (in huge natural containers)		1
Total			**6**

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

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