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.

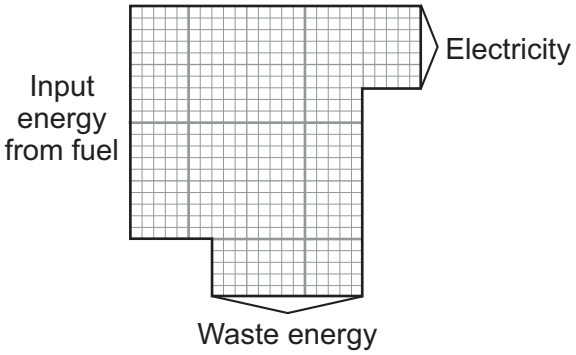
Advice
- In all calculations, show clearly how you work out your answer.

Do not write outside the box

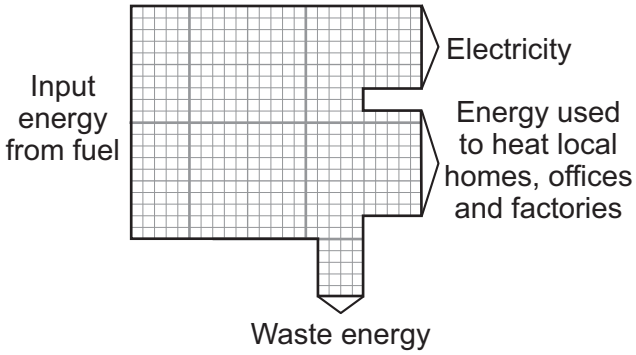
Answer **all** questions in the spaces provided.

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?

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(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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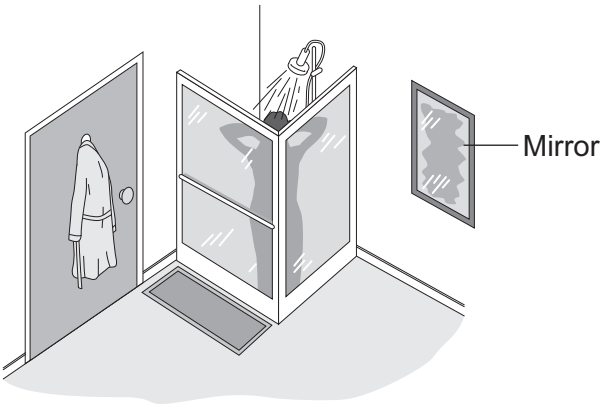
(1 mark)

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

Do not write outside the box

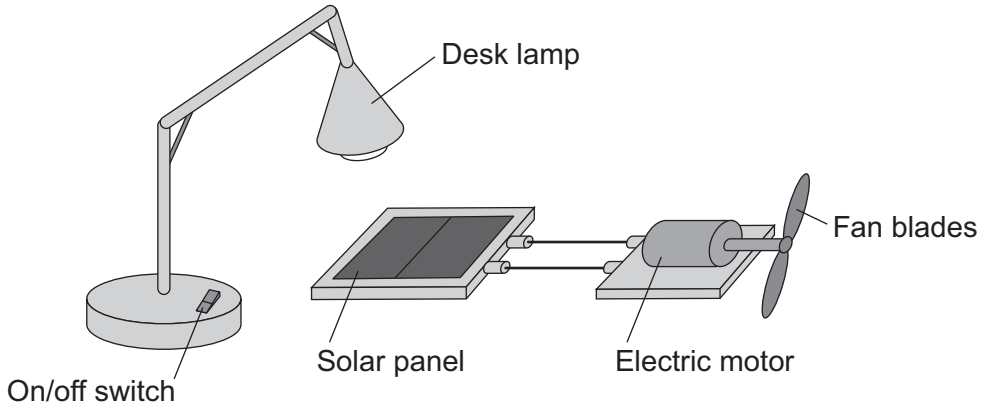
3 (a) Light waves transfer energy.

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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(2 marks)

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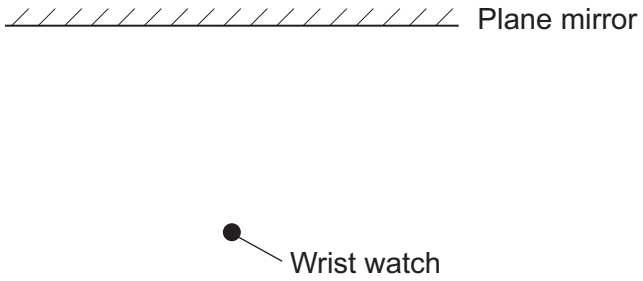
3 (b) A student holds a wrist watch in front of a plane mirror. The student can see an image of the wrist watch in the mirror.

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)

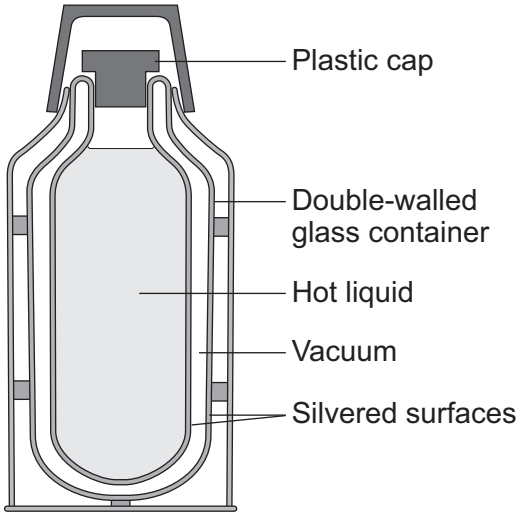
8

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

Turn over ▶

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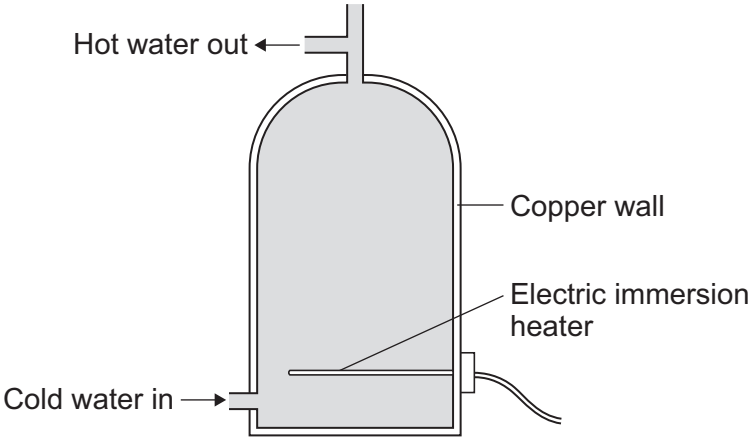
5 An electric immersion heater is used to heat the water in a domestic hot water tank. When the immersion heater is switched on the water at the bottom of the tank gets hot.



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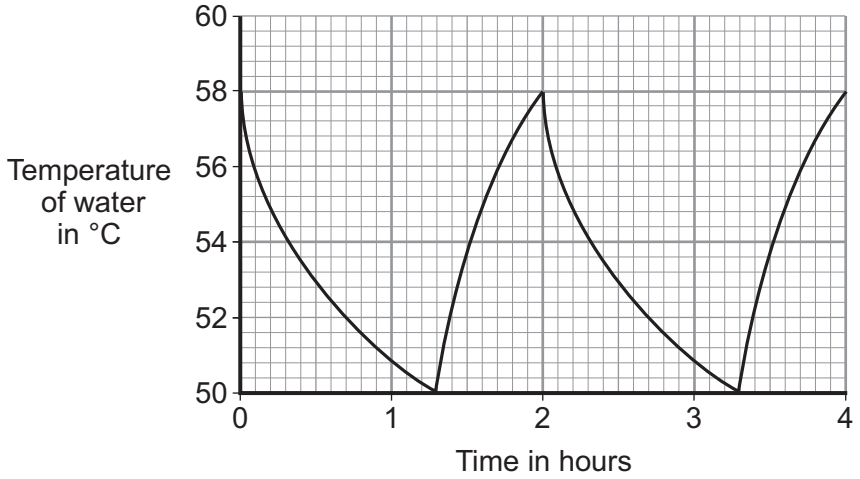
5 (c) The immersion heater has a thermostat to control the water temperature.

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

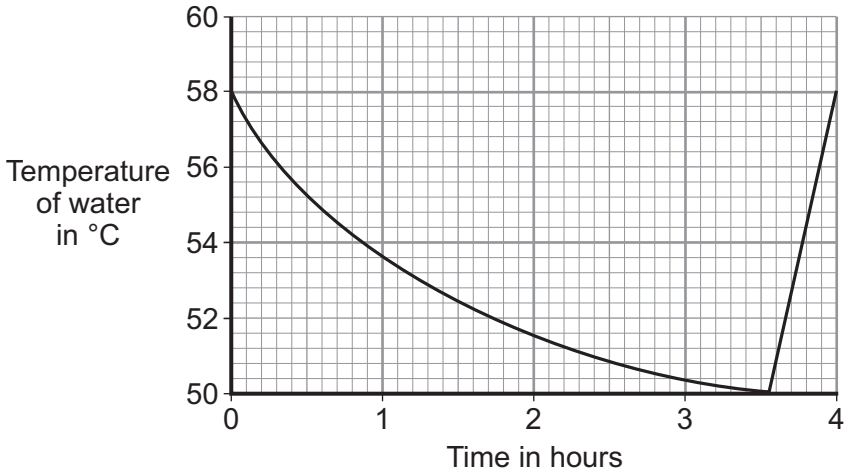
(3 marks)

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.

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(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?

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(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.

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(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.

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(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 …

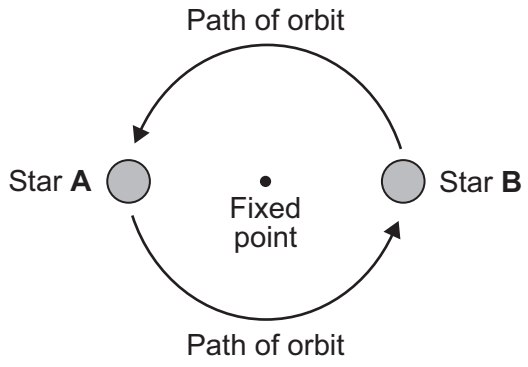
proved the 'Big Bang' theory to be correct. ☐

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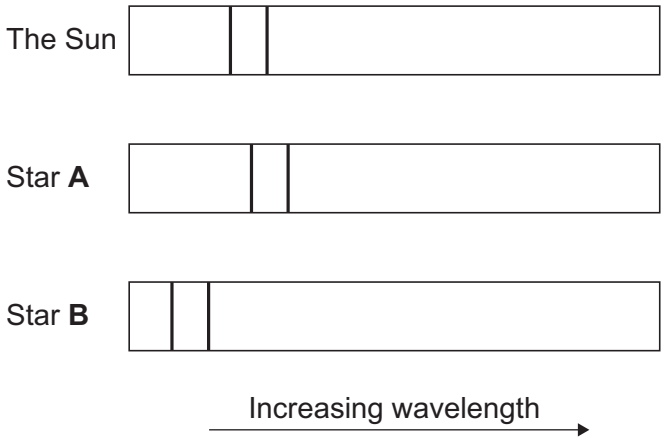
The diagram shows the position of two dark lines in the spectrum from the Sun. It also shows the same lines in the spectra from two stars **A** and **B** in a binary star system at the same point in time.



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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