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

Physics
Unit Physics P1

PH1HP

H

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.

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.

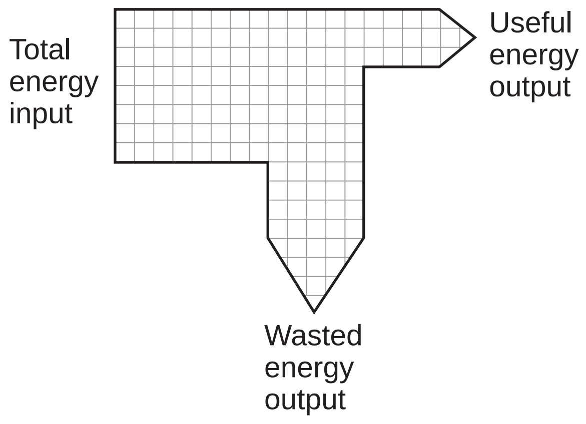
The electric motor transfers electrical energy usefully into .... energy.

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

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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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]

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

[1 mark]

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8

Turn over for the next question

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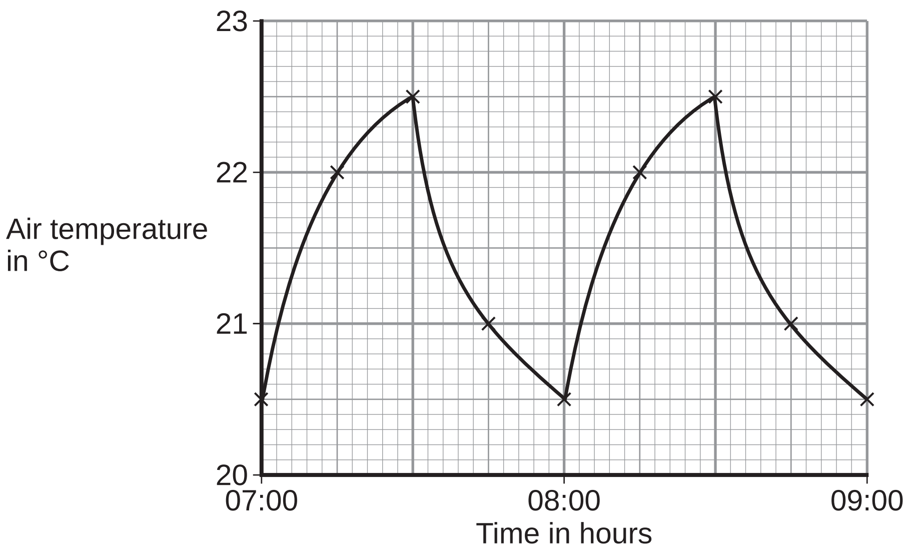
3 A householder monitored how the air temperature inside his house changed over a 2-hour period. The householder measured the temperature every 15 minutes.

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]

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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]

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Time = ... minutes

Question 3 continues on the next page

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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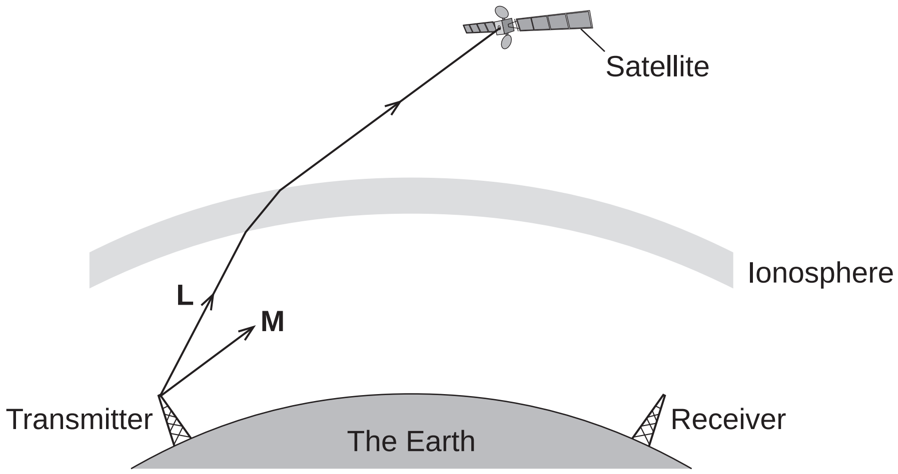
9

Turn over for the next question

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]

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2 ....

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7

Turn over for the next question

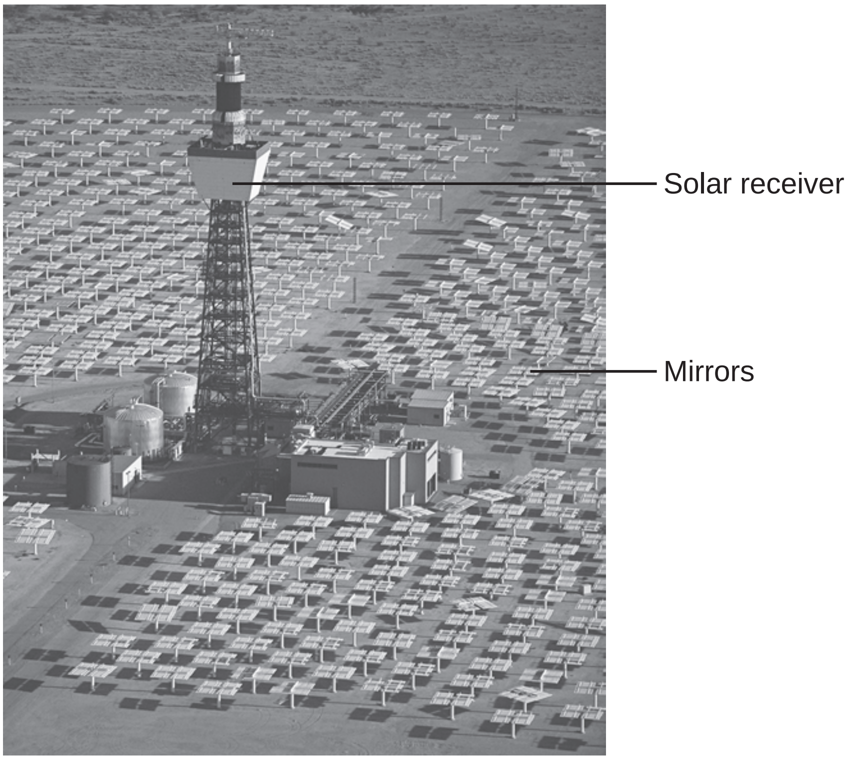
Do not write outside the box

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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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 ▶

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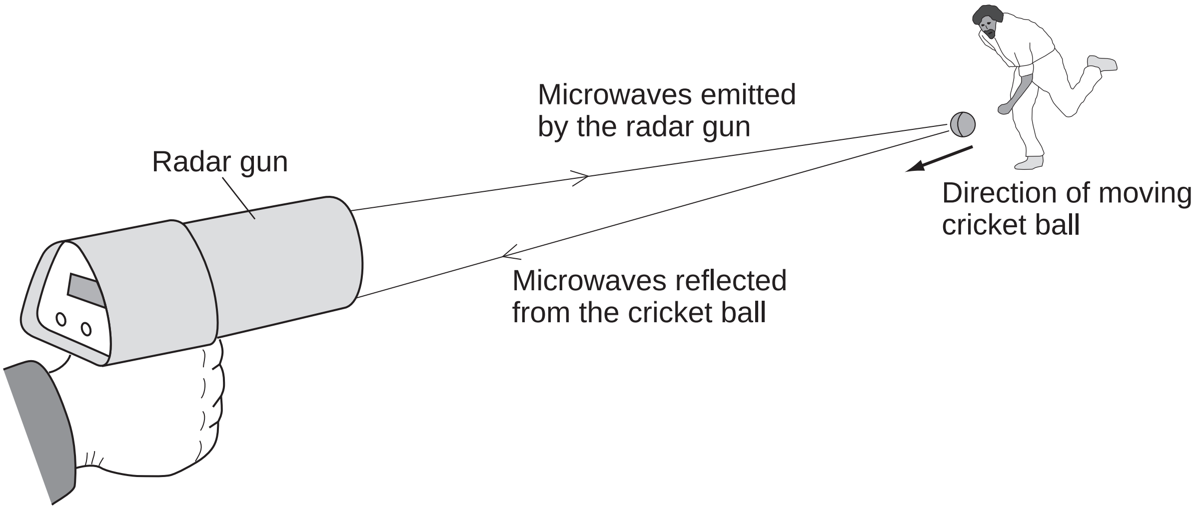
6 A radar gun is used to determine the speed of a cricket ball during a cricket match. The radar gun emits a beam of microwaves. The microwaves are reflected from the moving ball, as shown in **Figure 6**.

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]

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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

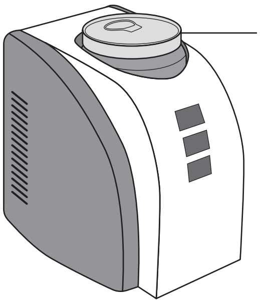
Turn over for the next question

Turn over ▶

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

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Question 5, Figure 5: © Getty