Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4463/02

W15-4463-02

SCIENCE A/PHYSICS

PHYSICS 1
HIGHER TIER

P.M. THURSDAY, 15 January 2015

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**16**	
3.	**8**	
4.	**7**	
5.	**6**	
6.	**15**	
Total	**60**	

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ADDITIONAL MATERIALS

In addition to this paper you may require a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

A list of equations is printed on page 2. In calculations you should show all your working.

You are reminded that assessment will take into account the quality of written communication (QWC) used in your answers to questions **2***(c)* and **6***(c)*.

Equations

density = $\frac{\text{mass}}{\text{volume}}$	$\rho = \frac{m}{V}$
power = voltage × current	$P = VI$
energy transfer = power × time	$E = Pt$
units used (kWh) = power (kW) × time (h) cost = units used × cost per unit	
% efficiency = $\frac{\text{useful energy [or power] transfer}}{\text{total energy [or power] input}} \times 100$	
wave speed = wavelength × frequency	$c = \lambda f$
speed = $\frac{\text{distance}}{\text{time}}$	

SI multipliers

Prefix	Multiplier
p	10^{-12}
n	10^{-9}
μ	10^{-6}
m	10^{-3}

Prefix	Multiplier
k	10^{3}
M	10^{6}
G	10^{9}
T	10^{12}

Examiner only

Answer **all** *questions.*

1. A hospital radiology department displays information about the dose a patient receives from different types of X-rays.

Type of X-ray	Received dose in units	Equivalent days of background radiation
Knee	1	1.5
Chest	2	3
Skull	10	15
Spine	100	150
Hip	30	45
Pelvis	100	150
Abdomen	150	225

(a) Explain why X-rays are a risk to the patient. [2]

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(b) Use information in the table to explain which type of X-ray is the most dangerous for the patient. [2]

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(c) A patient is told that he has received a total radiation dose of 140 units from X-rays.

(i) Calculate how many chest X-rays this dose is equivalent to. [2]

number of chest X-rays = ...

(ii) The mean background radiation a person receives is 43 200 counts each day. Calculate the counts of radiation received by the patient from this number of chest X-rays. [2]

counts received = ...

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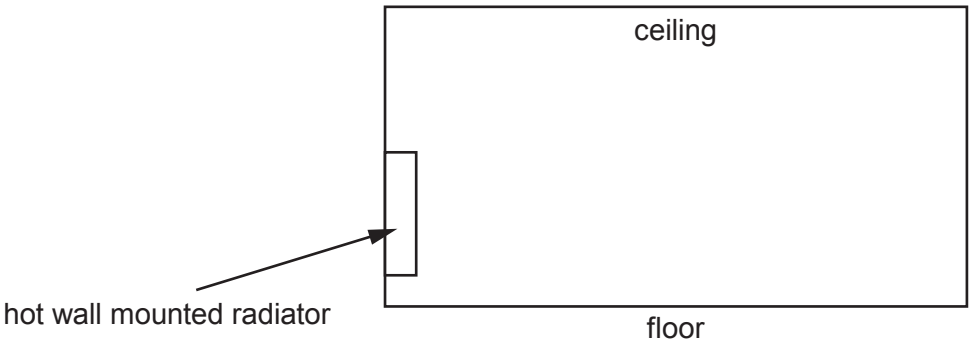
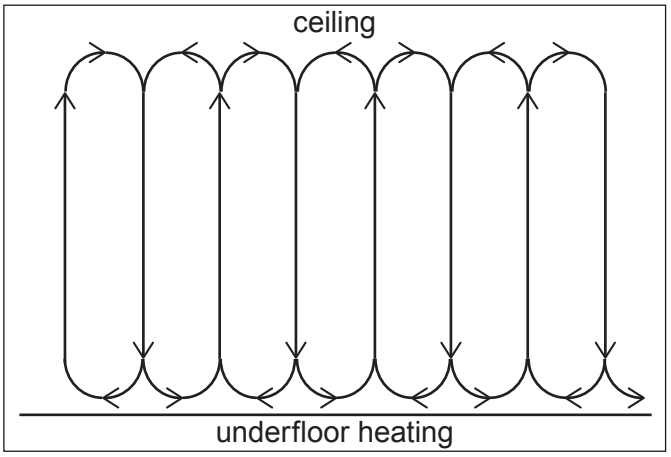
Turn over.

Examiner only

2. *(a)* (i) Complete the diagram below by adding arrows to show how air in a room is heated by convection. [2]



(ii) The diagram below shows air movement in a room with underfloor heating. All of the floor is heated with a grid of wires. They get hot when an electric current flows through them.



Explain why underfloor heating is more effective at heating the air in the room than the single wall mounted radiator. [2]

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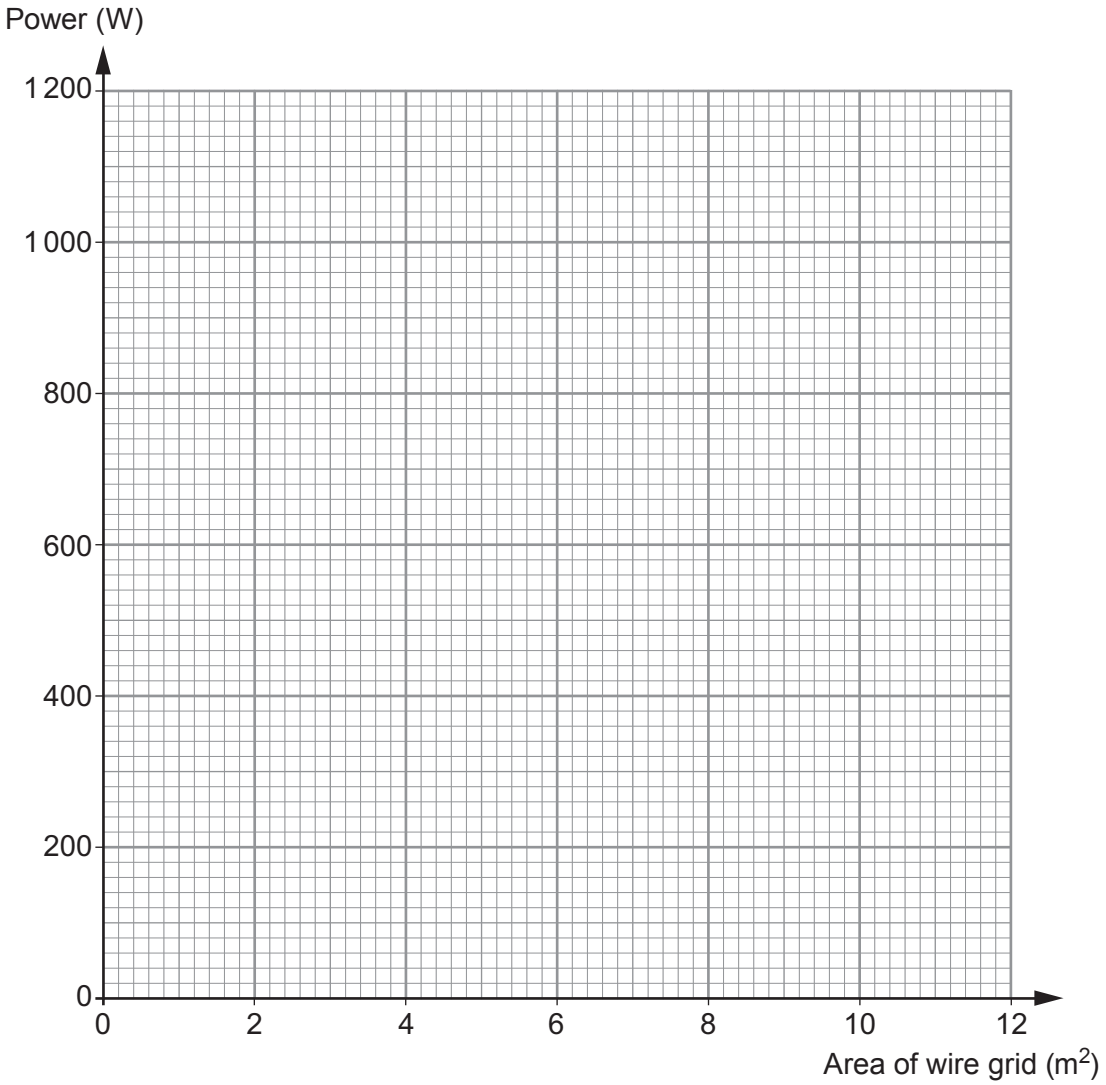
Examiner only

(b) The power produced by the wire grid depends on its area as shown in the table below.

Area of wire grid (m^2)	Power from wire grid (W)
0.0	0
1.0	150
2.0	300
4.0	600
6.0	900
8.0	1 200

(i) Plot the data on the grid below and draw a suitable line. [3]



(ii) Describe the relationship between the power and the area of the wire grid. [2]

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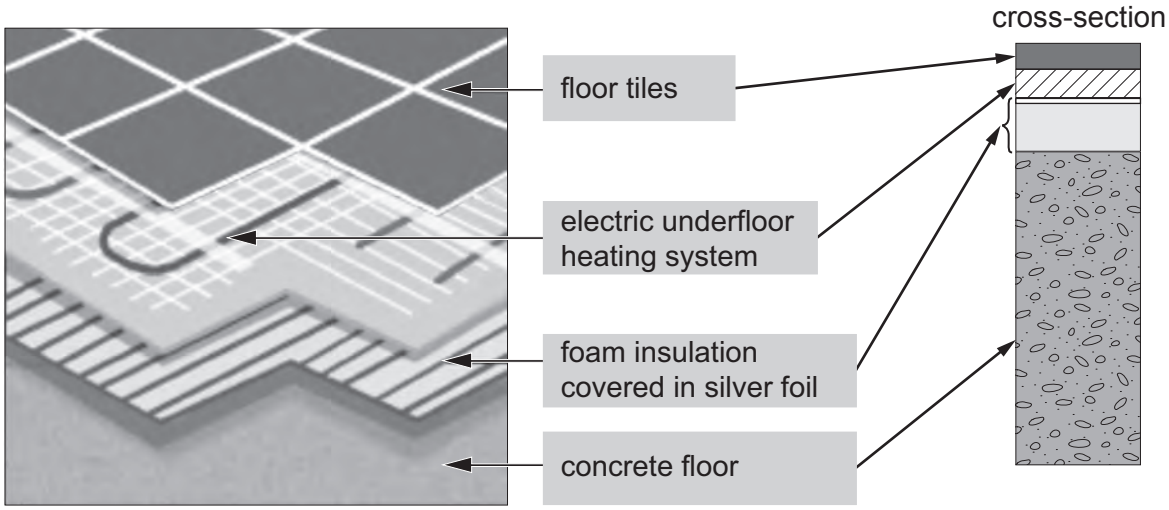
(iii) Use the data to find the power produced by a grid of area 12 m^2. ..... W [1]

Examiner only

(c) The diagrams show how the underfloor heating system is laid under tiles.



Explain how features in the diagrams above improve the effectiveness of heating the room. [6 QWC]

Include in your answer:

- why some of the heat transfers through the concrete floor;
- how this heat loss is reduced.

Examiner only

3. Drax is a large coal-fired power station with a generating capacity of 3950 MW. This power is transmitted through the National Grid to consumers with an efficiency of 92%.

(i) Explain how this high efficiency is achieved by the National Grid system. [3]

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(ii) Use an equation from page 2 to calculate the power available for use by consumers. [2]

power = ... MW

(iii) Mains electricity is supplied to a home at 230 V at a maximum current of 80 A.
Use an equation from page 2 and your answer to part (ii) to calculate the minimum number of homes that could be supplied by the Drax power station. [3]

number of homes = ...

8

Turn over.

Examiner only

4. The Andromeda Galaxy is 2.22×10^6 light years away from Earth. Part of its spectrum is shown below.

(i) How long does light from Andromeda take to reach Earth? [1]

time = ...

(ii) Explain how the dark lines crossing the spectrum are produced. [3]

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(iii) Fred Hoyle proposed the Steady-State theory of the Universe in 1948. This suggested that the Universe has always looked the same over time. Explain why red shift measurements **and** the discovery of Cosmic Microwave Background Radiation (CMBR) did not support this theory. [3]

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Examiner only

5. A mobile phone network uses microwaves to transmit signals between mobile phones and masts. The microwaves have a frequency of 1.5 GHz and travel at a speed of 3×10^8 m/s. The maximum distance that a phone can be from a mast and still receive a signal is 35 km.

(i) Use an equation from page 2 to calculate the wavelength of the microwaves. [3]

wavelength = ... m

(ii) Use an equation from page 2 to calculate the maximum time for a signal to travel from a phone to a mast 35 km away. [3]

time = ... s

6

Turn over.

Examiner only

6. *(a)* What is the purpose of the National Grid? [2]

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(b) A large wind turbine can supply a mean power of 0.95 MW to the National Grid. The table shows the **length of time** during a typical week when the turbine generated electricity.

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Length of time electricity generated (minutes)	495	0	1 440	900	600	1 440	525

(i) Using an equation from page 2 calculate the energy output (in MWh) of the wind turbine for the week. [3]

energy output = ... MWh

(ii) The cost of commissioning the wind turbine is £650 000. The electricity it produces is sold to the National Grid at 5 p per kWh. Calculate the expected payback time. (Payback time is the time taken to repay the £650 000 cost.) [4]
Assume the energy output for a typical week is constant.

payback time = ... weeks

Examiner only

(c) Discuss the advantages and disadvantages of using wind turbines such as in part *(b)* for the large scale production of electricity for distribution by the National Grid. [6 QWC]

Consider the following information when writing your answer:

- power demand from the National Grid is typically 40 GW;
- a nuclear power station typically produces an output of 2.5 GW;
- reliability of output;
- environmental considerations.

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END OF PAPER