Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4463/01

W15-4463-01

SCIENCE A/PHYSICS

PHYSICS 1
FOUNDATION TIER

P.M. THURSDAY, 15 January 2015

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**3**	
2.	**4**	
3.	**7**	
4.	**8**	
5.	**6**	
6.	**8**	
7.	**8**	
8.	**16**	
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 answer to question **8***(c)*.

Equations

density = $\frac{\text{mass}}{\text{volume}}$	$\rho = \frac{m}{V}$
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	
m	10^{-3}	$\frac{1}{1\,000}$
k	10^{3}	1 000
M	10^{6}	1 000 000

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Answer **all** *questions.*

1. The boxes on the left show the names of objects in the Universe.
The boxes on the right show the time taken for light to travel from these objects to Earth. They are not in order.
Draw a line from each box on the left to the correct box on the right. [3]

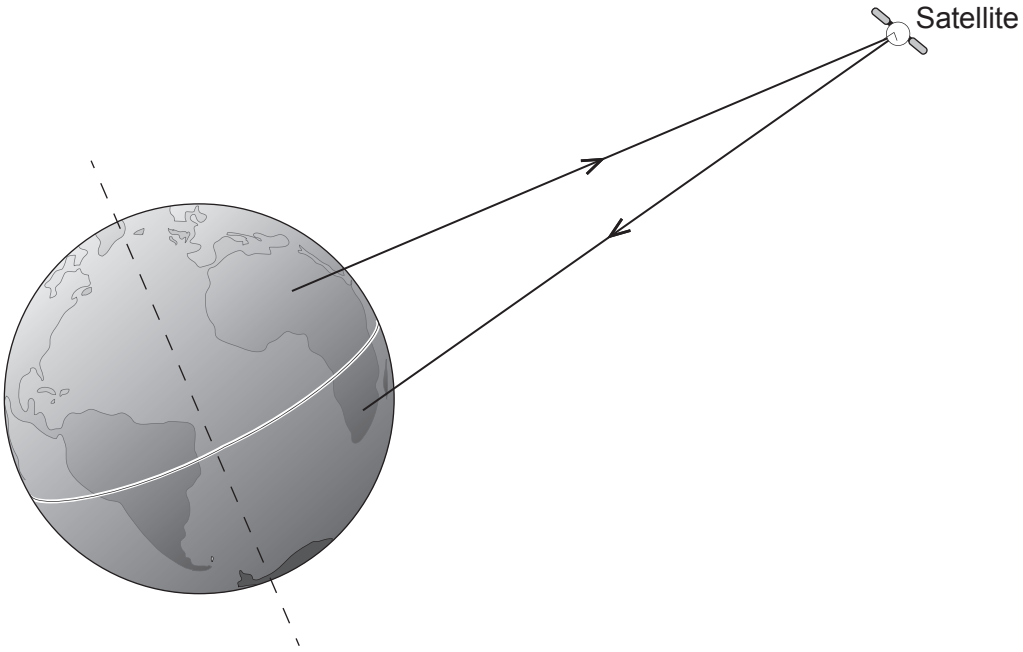
Objects in the Universe	**Time taken for light to travel to Earth**
The Sun	1.3 seconds
Alpha Centauri (a star in the Milky Way)	Over 2 million years
The Andromeda Galaxy	4.5 years
The Moon	500 seconds

3

Turn over.

Examiner only

2. A geosynchronous (geostationary) satellite orbits high above the Earth.
Geosynchronous satellites are used for relaying television programmes to our homes.
It takes **0.24 s** for a signal to get to the satellite from Earth.



(a) Put ticks (✓) in **three** boxes below next to the correct statements about this satellite. [3]

It stays above the same point on the Earth at all times. ☐

It relays radio waves. ☐

It orbits the Earth once in 365 days. ☐

It orbits the Sun once in 1 day. ☐

It relays microwave signals. ☐

It orbits above the equator. ☐

(b) State why a signal sent from a television studio by satellite takes **0.48 s** to reach your house. [1]

.....

.....

4

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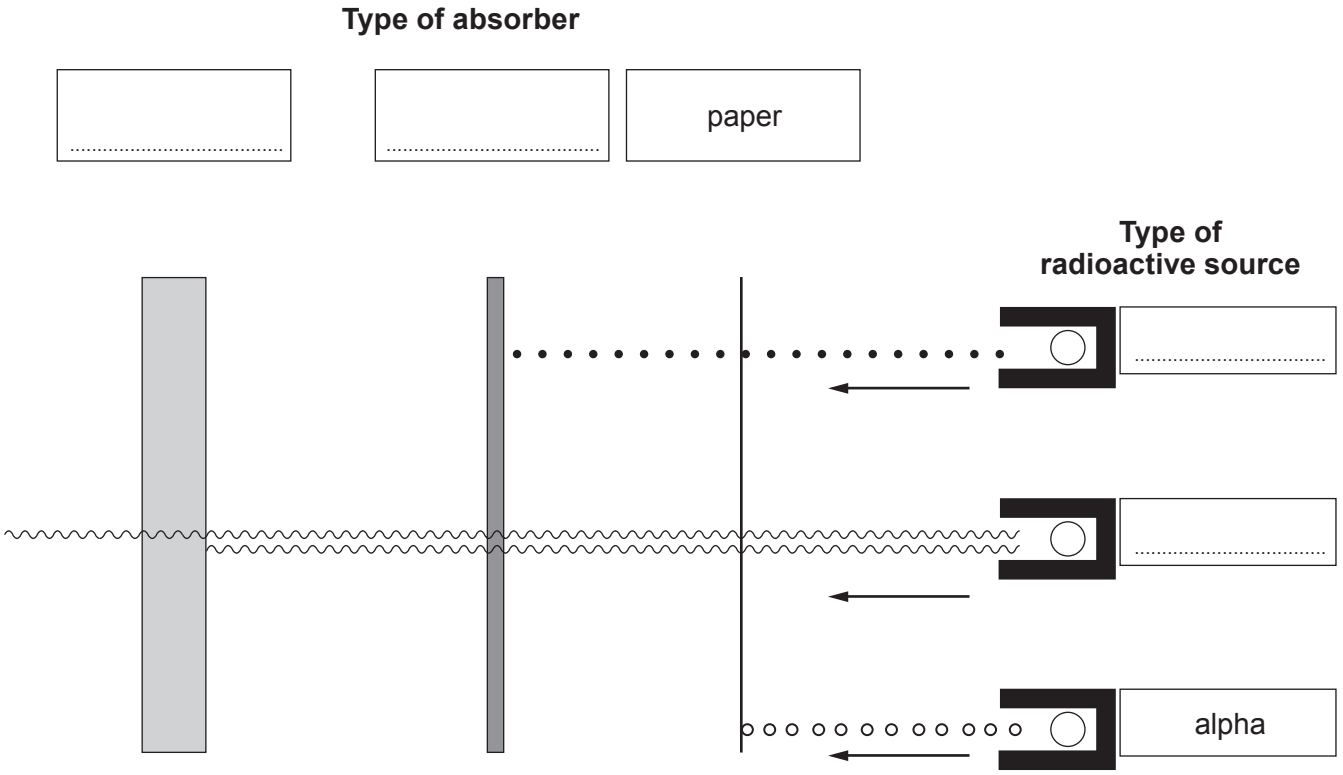
3. *(a)* The diagram shows three types of nuclear radiations being absorbed by different materials. Use the words below to complete the boxes on the diagram. [3]

beta **gamma** **lead** **aluminium**



4463 010005

Turn over.

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(b) The table shows the background count rate (in counts/min) taken in a laboratory at five different times.

	Measurement 1	Measurement 2	Measurement 3	Measurement 4	Measurement 5
Activity (counts/min)	30	32	28	29	31

(i) State why the readings are different. [1]

.....

(ii) Calculate the mean activity for the background radiation **and** convert your answer from counts per minute to counts per second (count/s). [2]

mean activity = ... counts/s

(iii) Name **one natural** source of background radiation. [1]

.....

7

Examiner only

4. The table gives some information about three electrical appliances.

Appliance	Power input (W)	Power wasted (W)	Useful power output (W)	Efficiency (%)
television	200	120	80	
security light	1 000	.....	300	30
microwave oven	.....	350	350	50

(a) **Complete the table** for the security light and microwave oven. [2]

(b) (i) Write the name of the unit shown by the letter W in the table. [1]

.....

(ii) Use an equation from page 2 to calculate the efficiency of the **television**. [2]

4463 010007

efficiency = ... %

(c) The security light is switched on for 4 hours.

(i) Use an equation from page 2 to calculate the number of units (kWh) used. [2]

units used = ... kWh

(ii) Use an equation from page 2 to calculate the cost of using the security light if electricity costs 15 p per unit. [1]

cost = ... p

8

Turn over.

Examiner only

5. The table gives some information about a nuclear power station and a wind turbine.

	How they compare	
	wind turbine	a nuclear power station
expected lifetime (years)	20	60
mean power output (MW)	2	2000
land area needed (km^2)	0.7	4.5
cost to commission (£)	3 million	4000 million
waste produced	none	radioactive waste
lifetime carbon footprint (g of CO_2/kWh)	4.6	5

Use data from the table to answer the following questions.

(a) (i) Calculate the number of wind turbines that would be needed to produce the same power as one nuclear power station. [1]

number of wind turbines = ...

(ii) Calculate the land area needed by a wind farm in order to produce the same power as one nuclear power station. [2]

area = ... km^2

(iii) How many wind turbines would need to be built every 60 years to provide the same power as one nuclear power station? [2]

number of wind turbines = ...

(b) State **one** advantage of producing electricity by nuclear power compared with wind turbines. [1]

.....

.....

.....

6

Examiner only

6. In an answer to an examination question, one candidate wrote the following description of the National Grid. It earned no marks.

"The National Grid is *a system of pylons* that sends electricity from *transformers to factories."*

(a) State how **this** answer can be improved by changing the words in italics. [3]

system of pylons

.....

transformers

.....

to factories

.....

(b) Transformers are used in the National Grid. Step-up transformers reduce the current.

(i) Give a reason why they are called step-up transformers. [1]

.....

(ii) State the reason for reducing the current. [1]

.....

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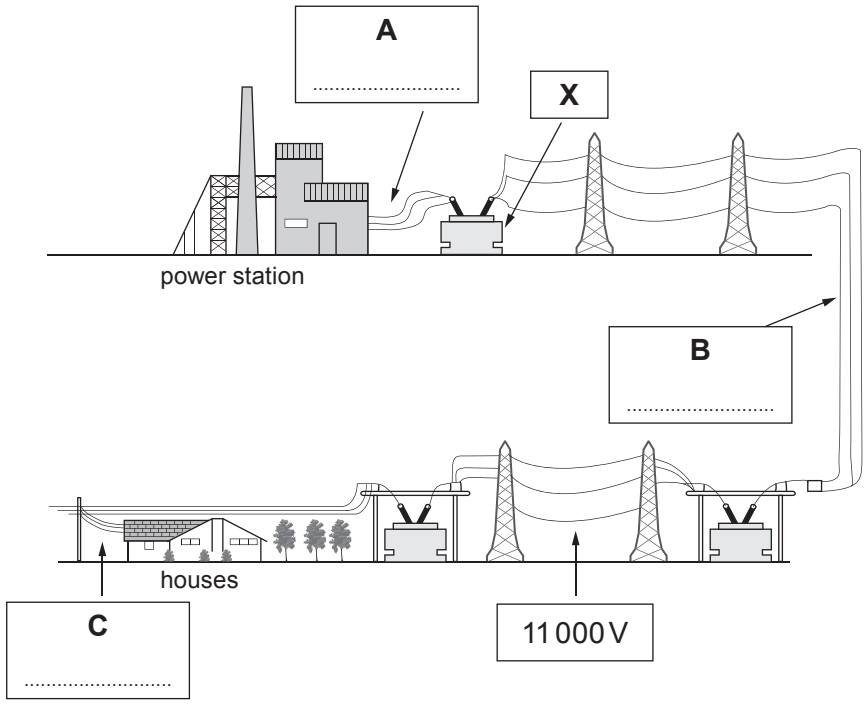
(c) The diagram shows part of the National Grid.
Voltages used in the grid are 230 V, 50 000 V and 132 000 V.

(i) Write the voltages at **A**, **B** and **C**. [2]



(ii) Name the object labelled **X** on the diagram. [1]

.....

8

Examiner only

7. 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]

.....

.....

.....

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

.....

.....

.....

(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 = ...

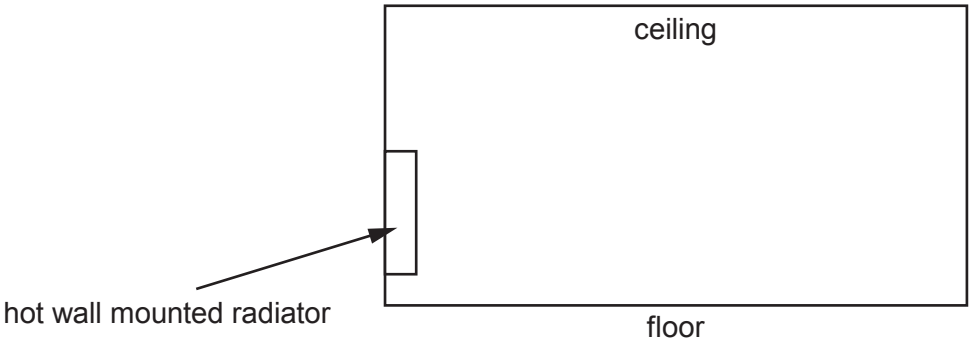
(ii) The mean background radiation a person receives is 43 200 counts each day. Calculate the counts of radiation received by the patient from this number of chest X-rays. [2]

counts received = ...

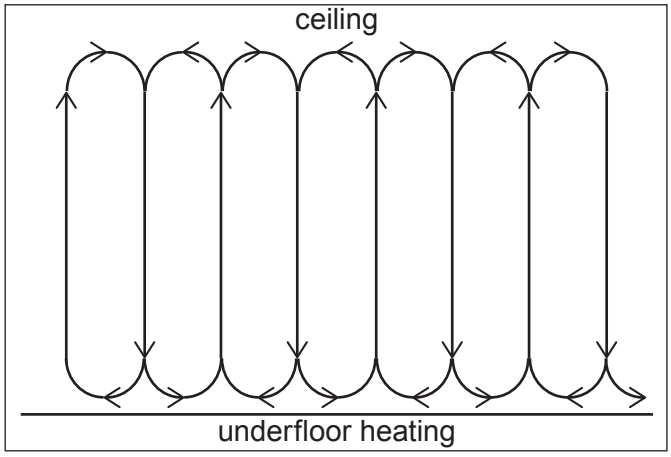
8

Examiner only

8. *(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]

.....

.....

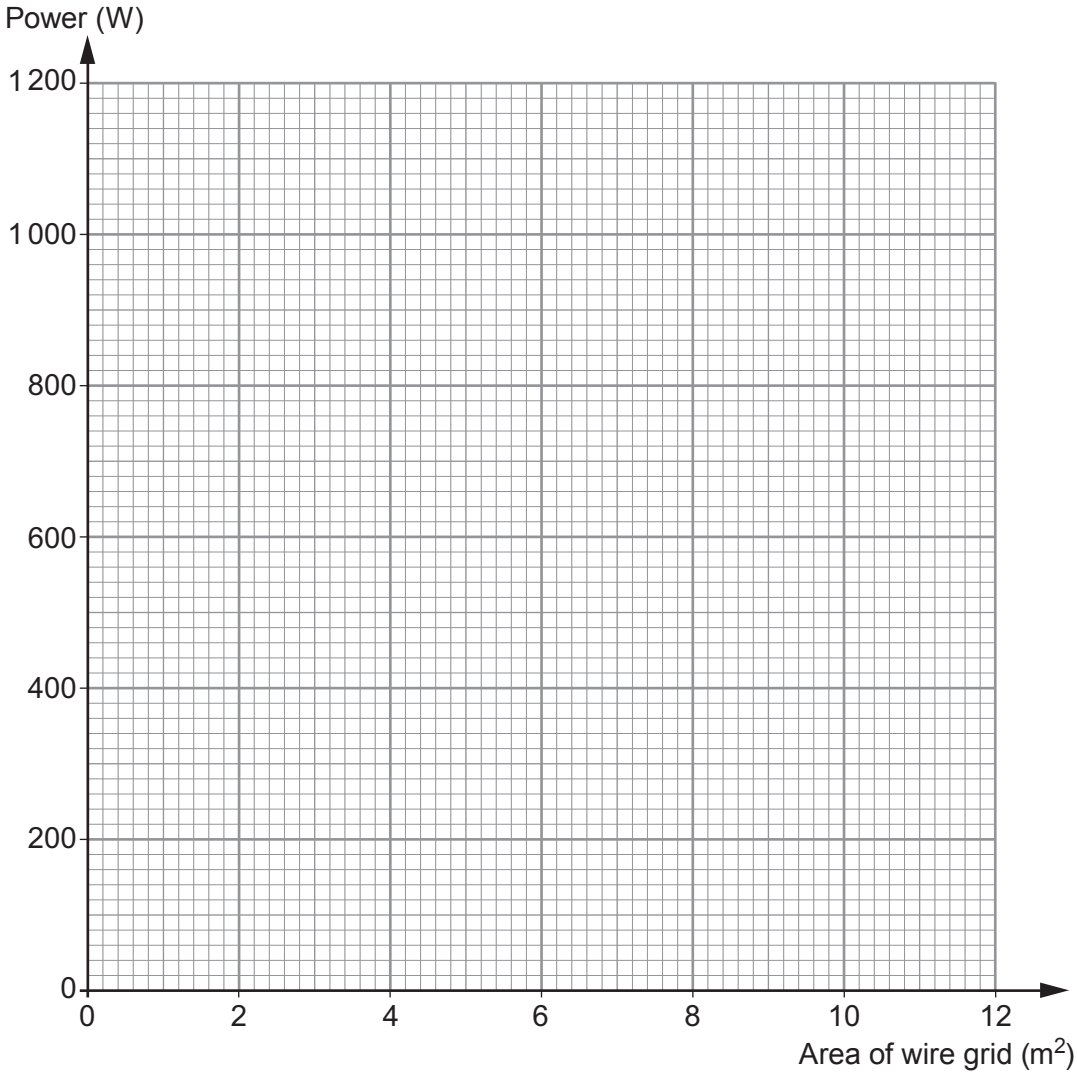
.....

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

Examiner only

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	1200

(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]

.....

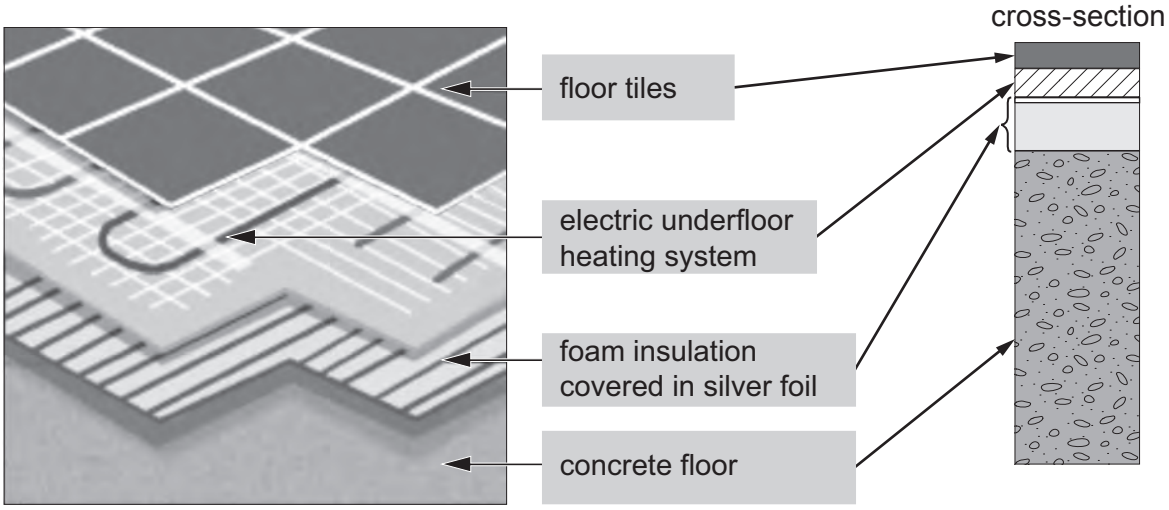
.....

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

TURN OVER FOR THE REST OF THE QUESTION

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.

END OF PAPER

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