Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4463/02

S15-4463-02

SCIENCE A/PHYSICS

PHYSICS 1
HIGHER TIER

A.M. MONDAY, 15 June 2015

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**13**	
2.	**13**	
3.	**8**	
4.	**10**	
5.	**10**	
6.	**6**	
Total	**60**	

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ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler.

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 questions **2***(d)* and **6**.

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}

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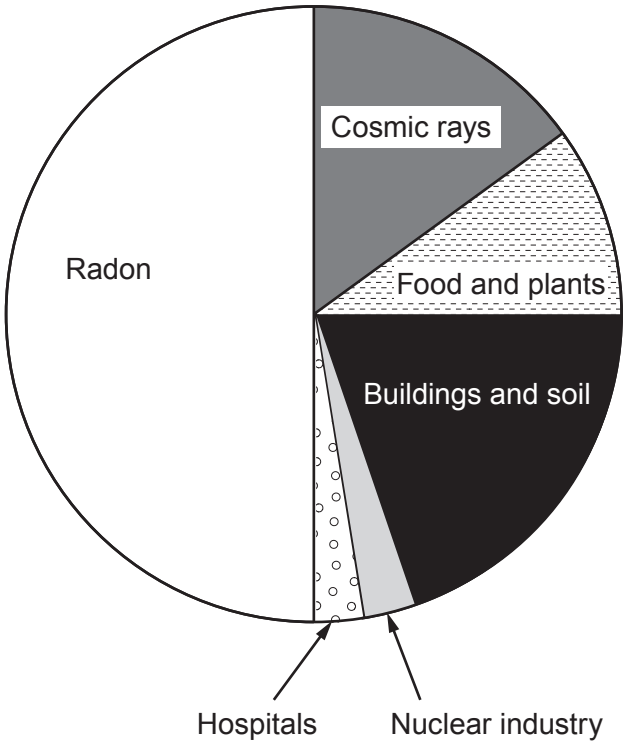
Answer **all** *questions.*

1. The sources of background radiation in a part of the U.K. are shown in the pie chart below.



(a) A single reading of the total background radiation showed 20 counts taken in a minute.

(i) Calculate the total number of counts per minute (cpm) from cosmic rays and food and plants **together**. [2]

..... cpm

(ii) Describe how a more reliable value of the total background radiation could have been found. [2]

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(iii) Give the name of **one** source of background radiation that depends largely on the rocks in the area in which the measurement is taken. [1]

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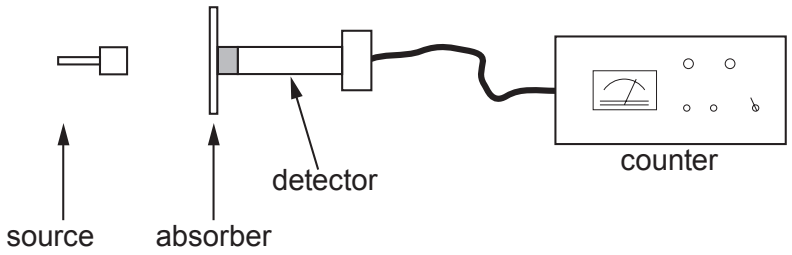
(b) A radiation detector is connected to a counter in a classroom. Absorbers were placed directly in front of the detector in an attempt to find which radiation was being given off by the radioactive source americium-241.



The following results were obtained.
The figures **include** the mean background radiation count of 20 cpm.

Absorber	Reading obtained (counts per minute)
none	350
thin card	20
3 mm of aluminium	21
20 mm lead	1

Use the information in the table above and your knowledge of radioactivity to answer the following questions.

(i) Calculate the mean number of counts per minute emitted by the americium-241. [2]

..... cpm

(ii) Explain which **type** of radiation is given off by the source. [2]

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(iii) Give a reason why pupils in the class did not need to be shielded from the source's radiation. [1]

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(iv) Explain how the data shows that background radiation is mainly gamma. [2]

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(v) State why the count rates measured beyond the aluminium are different from the mean background count. [1]

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Turn over.

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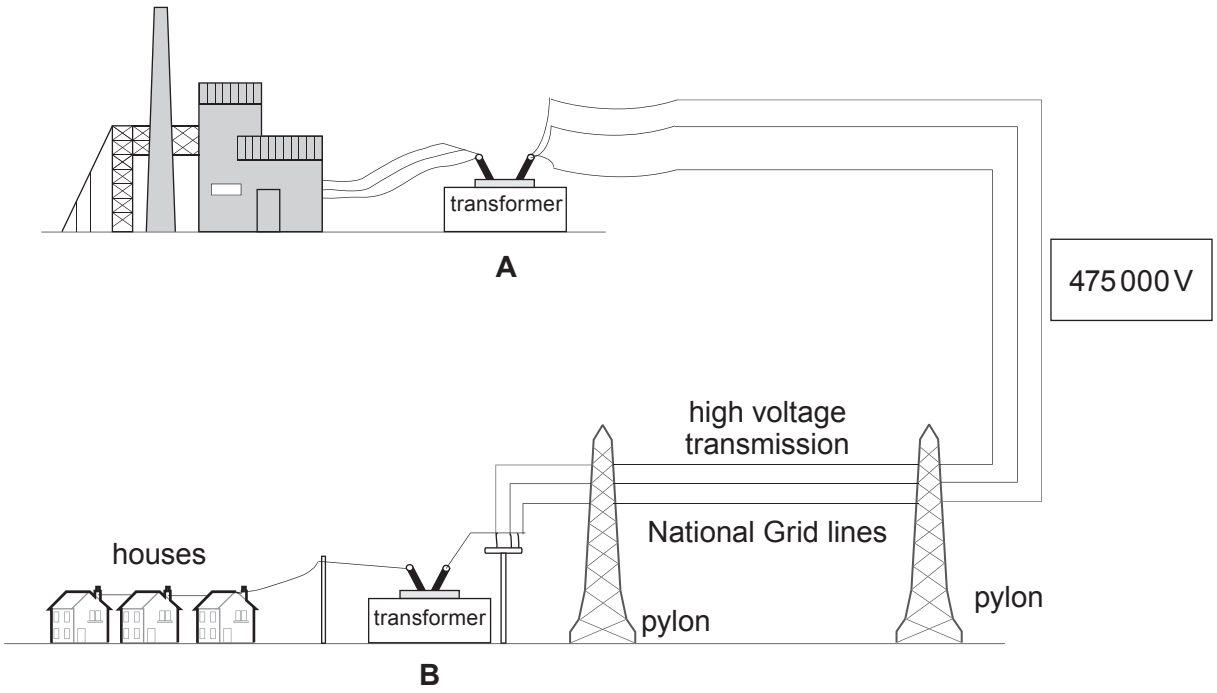
2. A diagram of the National Grid is shown below.



(a) Explain how transformer **A** makes the National Grid more efficient. [2]

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(b) Transformer **A** supplies 950 MW to the National Grid at 475 000 V.

(i) Write down the input power to the National Grid in watts. [1]

power = ... W

(ii) Use an equation from page 2 to calculate the current. [2]

current = ... A

(c) Explain the purpose of transformer **B**. [2]

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(d) Discuss how the National Grid maintains a reliable supply of electricity to consumers. [6 QWC]

Include in your answer:

- how the demand for electricity changes through the day;
- which types of power stations generate electricity continuously;
- why hydroelectric power stations are so useful to the National Grid.

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Turn over.

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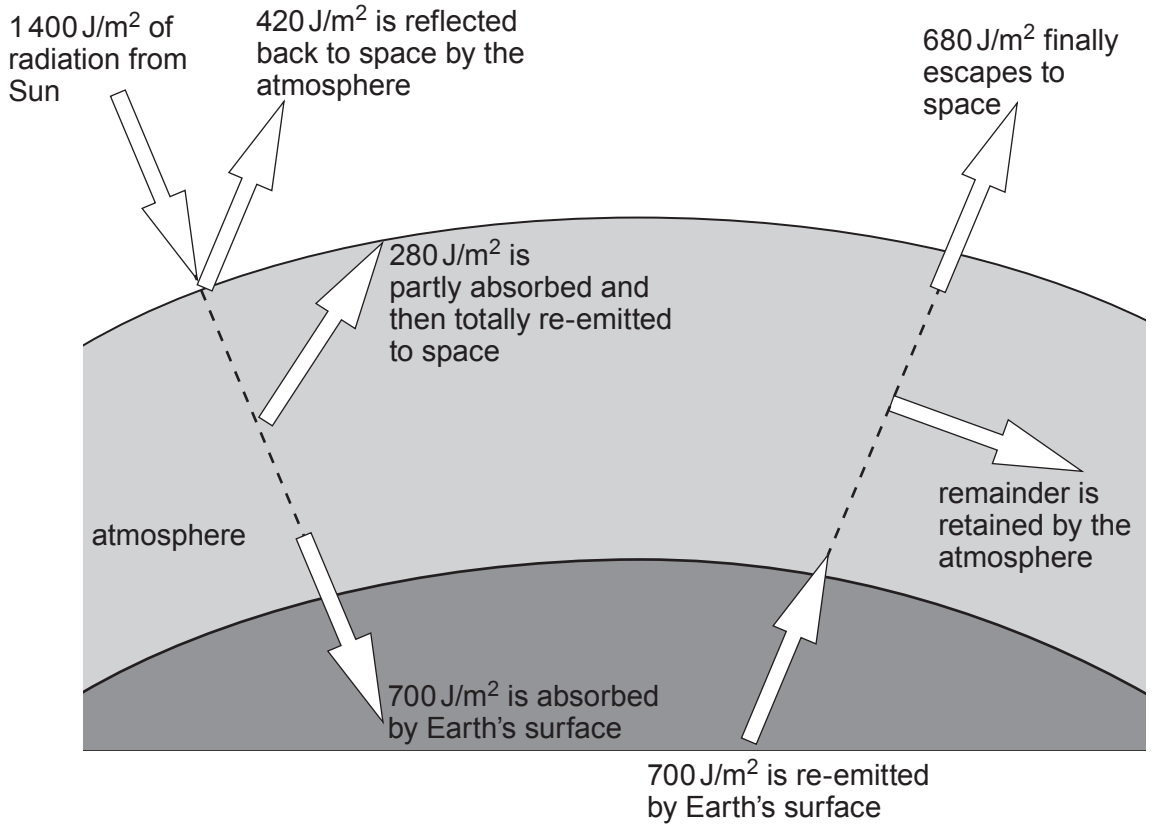
3. Some of the energy from the Sun strikes the Earth. At one period in time, what happened to the energy falling on each m^2 in 1 second is shown on the diagram below.



Use the diagram above to answer the following questions.

(a) (i) Calculate the energy per m^2 from the Sun that is retained by the atmosphere each second. [1]

..... J/m^2

(ii) A solar panel is designed to produce electricity from radiation received from the Sun. Such a panel is 20% efficient at converting the energy striking it.
Calculate the area of the solar panels that is needed to give an output of 1 kJ every second. [4]

area = ... m^2

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(b) Describe, giving named parts of the electromagnetic spectrum, how the presence of the atmosphere causes the greenhouse effect. (Hint: Do not use **data** from the diagram opposite.) [3]

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Turn over.

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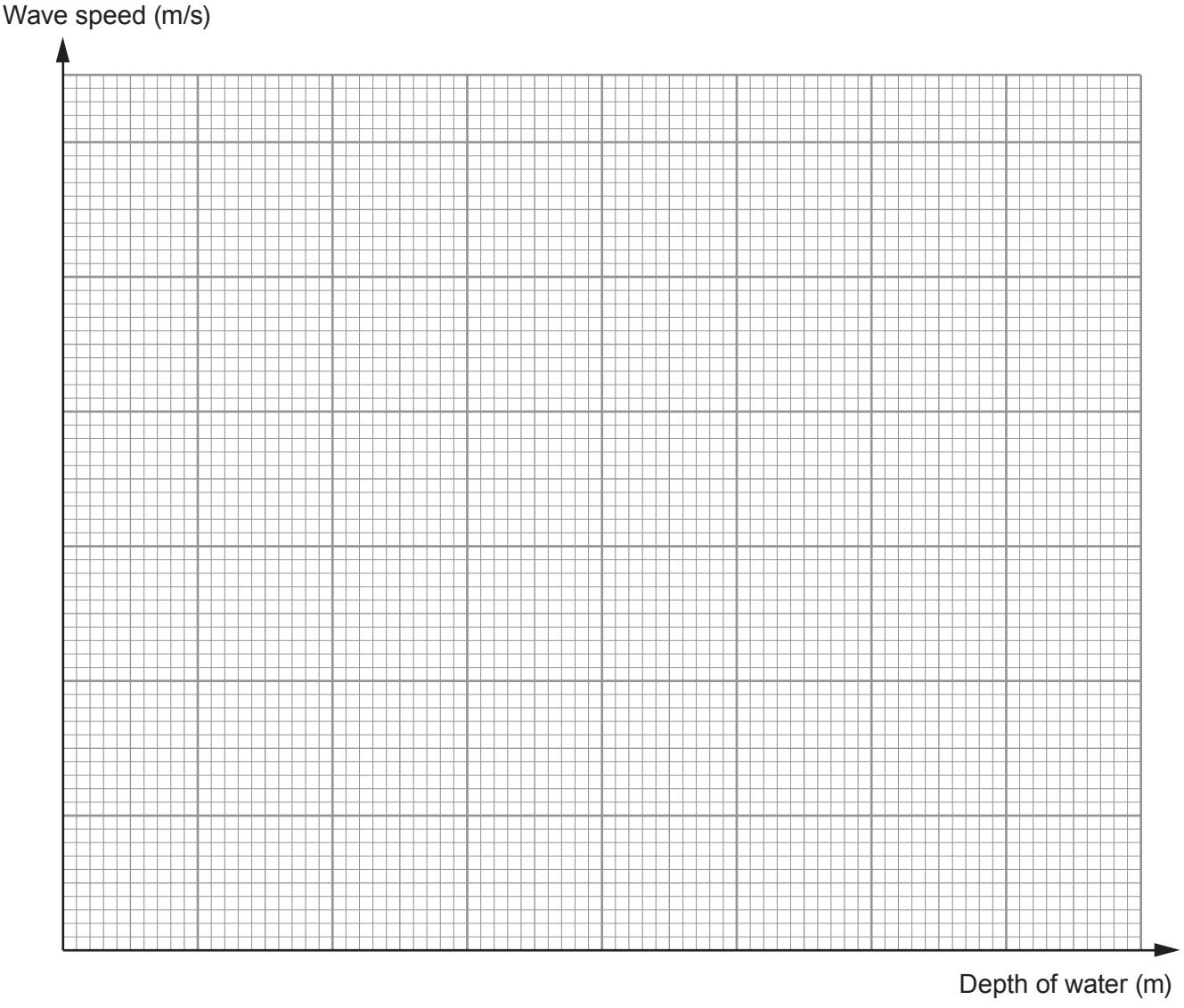
4. The data below shows how the speed of water waves changes with the depth of water.

(a) (i) Use the data in the table below to plot a graph on the grid below. [3]

Depth of water (m)	Wave speed (m/s)
0.0	0.0
0.5	1.8
1.5	3.8
2.5	4.9
3.5	5.7
4.0	6.0



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(ii) Describe how the wave speed changes with the depth of water. [2]

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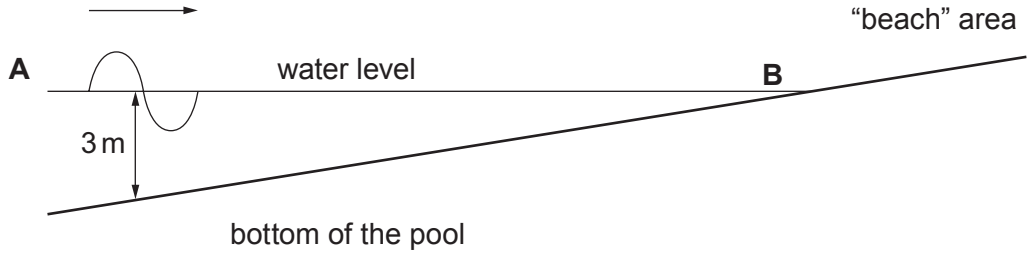
(b) Use the graph to answer the following question.
Water waves produced by a wave machine in a swimming pool have a wavelength of 8.1 m where the depth of water is 3.0 m.

(i) Use an equation from page 2 to calculate the frequency of these waves in the pool. [3]

frequency = ... Hz

(ii) As the waves travel from **A** to **B** in the pool, their frequency remains constant. Explain what happens to their wavelength. [2]



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5. Solar panels are fitted to a house. They save money in two ways:

- they reduce the number of units of electricity bought from the National Grid, saving 16 p per unit;
- in addition, the government pays a feed-in tariff of 14 p for every unit of electricity generated.

A householder spends £7 500 fitting solar panels to their roof. The mean power output is 3 kW and they generate 3 900 units (kWh) in one year (52 weeks). The householder uses all of these units.

(a) Use an equation from page 2 to calculate the mean number of hours a week for which the solar panels generate electricity. [2]

time = ... hours

(b) (i) Calculate the expected pay-back time for the system. [4]

time = ... years

(ii) Explain how this pay-back time would be affected if the cost of a unit of electricity increased. [2]

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(c) It is estimated that fitting photo-voltaic (p.v.) systems reduces CO_2 emissions by 0.5 kg for every unit (kWh) of electricity produced. Calculate how much CO_2 will be saved by this household in total if the solar panels have a lifetime of 25 years. [2]

CO_2 savings = ... kg

10

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6. Discuss the evidence for the Big Bang theory.
Include in your answer reference to the following:

- cosmological red shift of spectra from distant stars and galaxies;
- Cosmic Microwave Background Radiation (CMBR). [6 QWC]

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