Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4463/01

S15-4463-01

SCIENCE A/PHYSICS

PHYSICS 1
FOUNDATION TIER

A.M. MONDAY, 15 June 2015

1 hour

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	12	
2.	12	
3.	7	
4.	5	
5.	13	
6.	11	
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 question **6**(*d*).

Equations

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

SI multipliers

Prefix	Multiplier	
m	10^{-3}	$\dfrac{1}{1\,000}$
k	10^{3}	1 000
M	10^{6}	1 000 000

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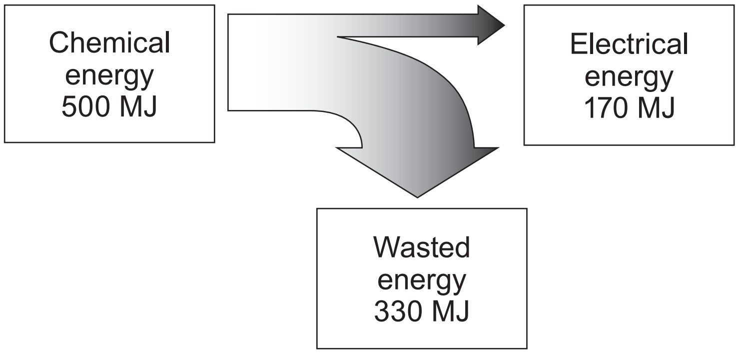
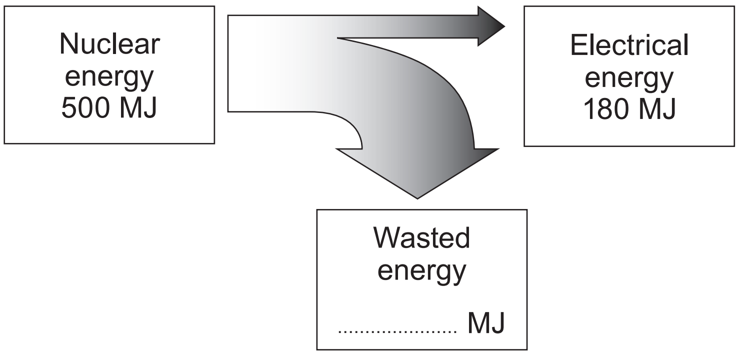
Answer **all** *questions.*

1. The three diagrams below show the overall energy transfers in three different types of thermal power stations.

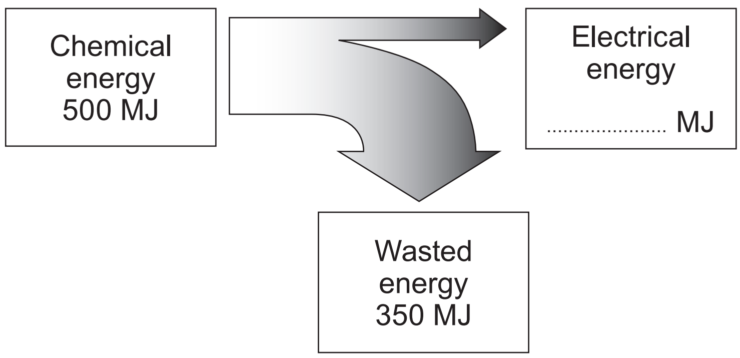
A. Oil power station



B. Nuclear power station



C. Coal power station



(a) **Complete the diagrams** above to show the missing energy values. [2]

(b) Use information from the above diagrams to answer the questions below.

(i) Which type of energy is the input energy in an oil power station? [1]

....

(ii) Which type of energy is the useful output energy in each power station? [1]

....

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(c) (i) Name the type of power station with the biggest wasted energy. [1]

....

(ii) Explain how this energy may be wasted. [2]

....

....

....

(d) Use an equation from page 2 to calculate the % efficiency of the oil power station. [2]

% efficiency = ...

(e) Waste products from power stations can affect the environment.

Complete the table below to describe the **environmental problems** caused by each waste product. [3]

Type of power station	Waste product	Environmental problem
oil	carbon dioxide	....
nuclear	radioactive material	....
coal	sulfur dioxide	....

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2. *(a)* The diagram shows an incomplete electromagnetic (em) spectrum.

(i) Choose words or phrases from the box to fill in the gaps in the em spectrum below. [3]

Sound waves	Microwaves	Ultraviolet waves	Gamma rays

....	X-rays	....	Visible light	Infra-red	....	Radio waves

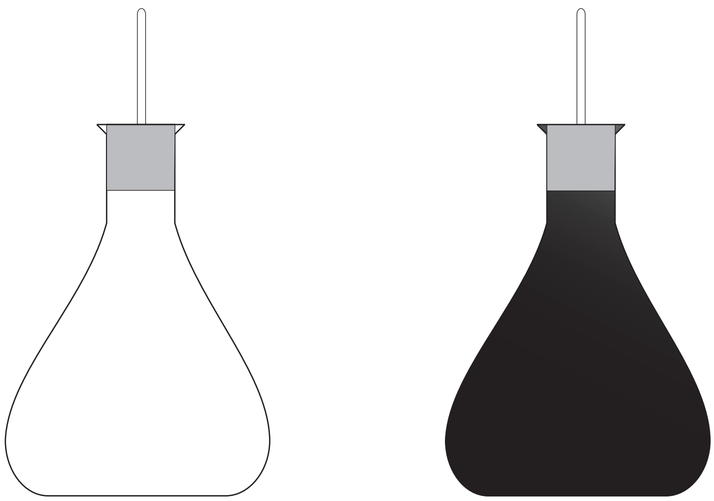
(ii) Underline the correct term in each bracket below. [3]

Infra-red waves travel **[faster than / slower than / at the same speed as]** radio waves in space.

Infra-red waves have wavelengths **[longer than / shorter than / the same as]** radio waves.

Infra-red waves have frequencies **[lower than / higher than / the same as]** X-rays.

(b) An experiment was set up to investigate the cooling of water in two flasks. One flask was painted shiny white. The other was painted matt black.



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(i) The starting temperature of the hot water poured into both flasks was 80 °C.

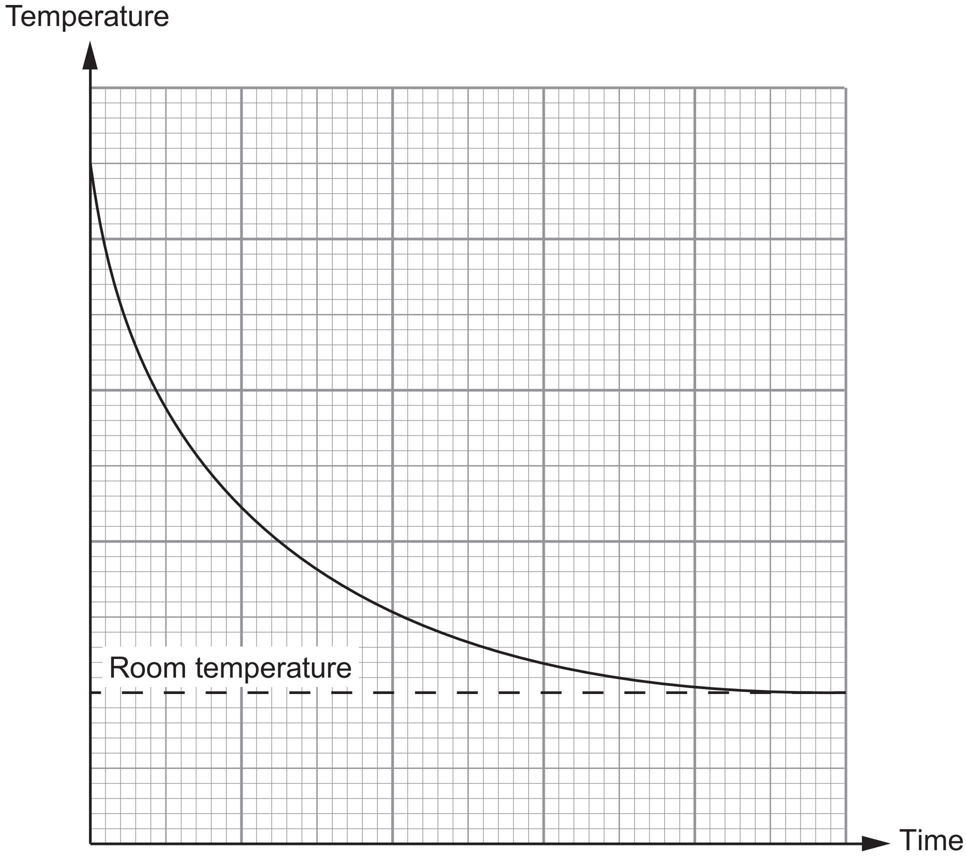
Explain what other quantity had to be kept the same in both flasks to make the experiment fair. [2]

....

....

....

(ii) The graph below shows how the temperature of water in the white flask changed until it reached room temperature.



I. **Add a line to the graph** to show the cooling curve for water in the black flask. [2]

II. Explain the difference between the two cooling curves. [2]

....

....

....

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3. Solar panels are fitted to a house.

(a) They save money for the householder 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 the householder a feed-in tariff of 14 p for every unit of electricity generated.

(i) What is the householder's **total** saving for each unit used from the solar panels? [1]

.... p

(ii) Each year the householder uses 4 000 units of electricity generated by the solar panels. Calculate the total saving in a year using the equation: [2]

$$\text{total saving in a year} = \text{total saving per unit} \times \text{number of units}$$

saving = ...

(iii) The solar panels produce electricity for 2 000 hours each year.

Calculate the mean power output of the solar panels using the equation: [2]

$$\text{power (kW)} = \frac{\text{units used}}{\text{time (h)}}$$

power = ... kW

(b) It is estimated that fitting solar panels reduces CO_2 emissions by 0.5 kg for every unit of electricity produced. Calculate how much CO_2 will be saved by this household each year. [2]

CO_2 savings = ... kg

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4. *(a)* Some common distance units used in astronomy are:

- 1 light year = the distance that light travels in one year;
- 1 parsec (pc) = 3.3 light years;
- 1 kiloparsec (kpc) = 1 000 parsecs = 3 300 light years;
- 1 astronomical unit (AU) = the distance between the Earth and the Sun = 150 million km.

Use the information above to answer the following questions.

(i) How many years does it take light to travel 1 parsec? [1]

.... years

(ii) Our galaxy is about 30 kpc in diameter. What is its diameter in light years? [1]

diameter = ... light years

(iii) The distance between the Sun and Neptune is 30 AU. What is this distance in million km? [1]

distance = ... million km

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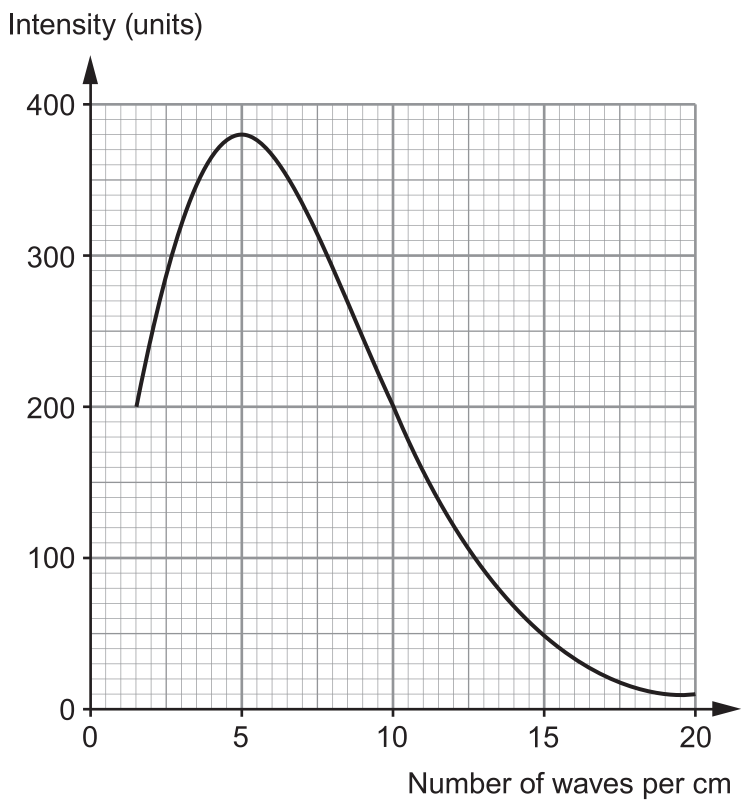
(b) Cosmic Microwave Background Radiation (CMBR) fills the entire universe. The spectrum of the CMBR is shown on the graph below.



Use the graph to answer the following questions.

(i) State the intensity of the most intense microwaves detected. [1]

.... units

(ii) State the number of waves per cm for the most intense microwaves. [1]

number of waves per cm = ...

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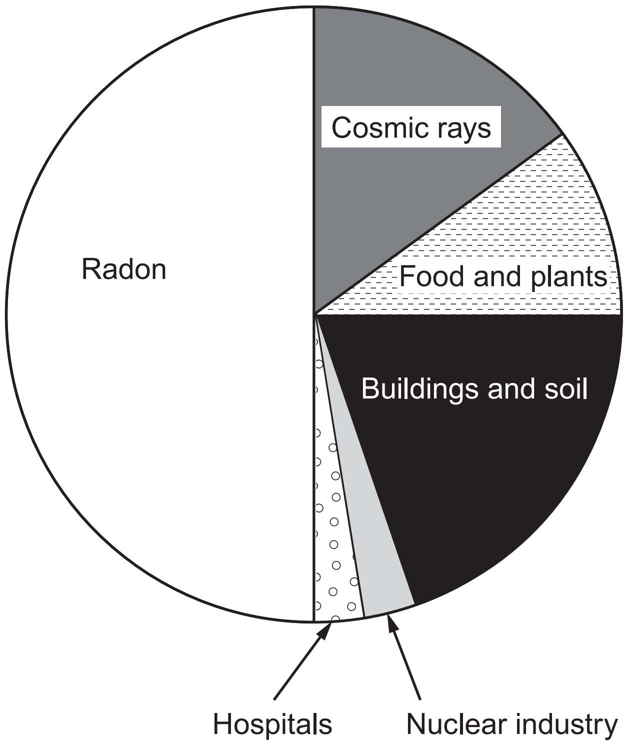
5. The sources of background radiation in a part of the U.K. are shown in the pie chart below.



(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]

....

....

....

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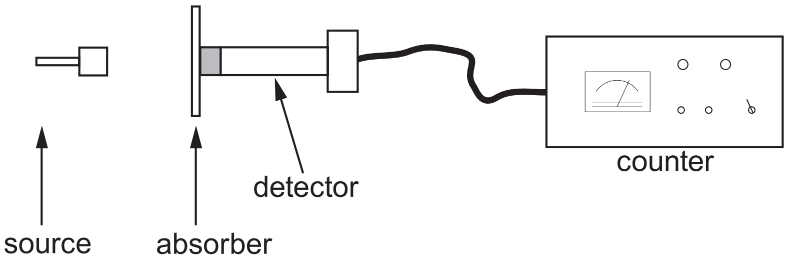
(b) A radiation detector is connected to a counter in a classroom. Absorbers were placed directly in front of the detector in an attempt to find which radiation was being given off by the radioactive source americium-241.



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]

....

....

....

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

....

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

....

....

....

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

....

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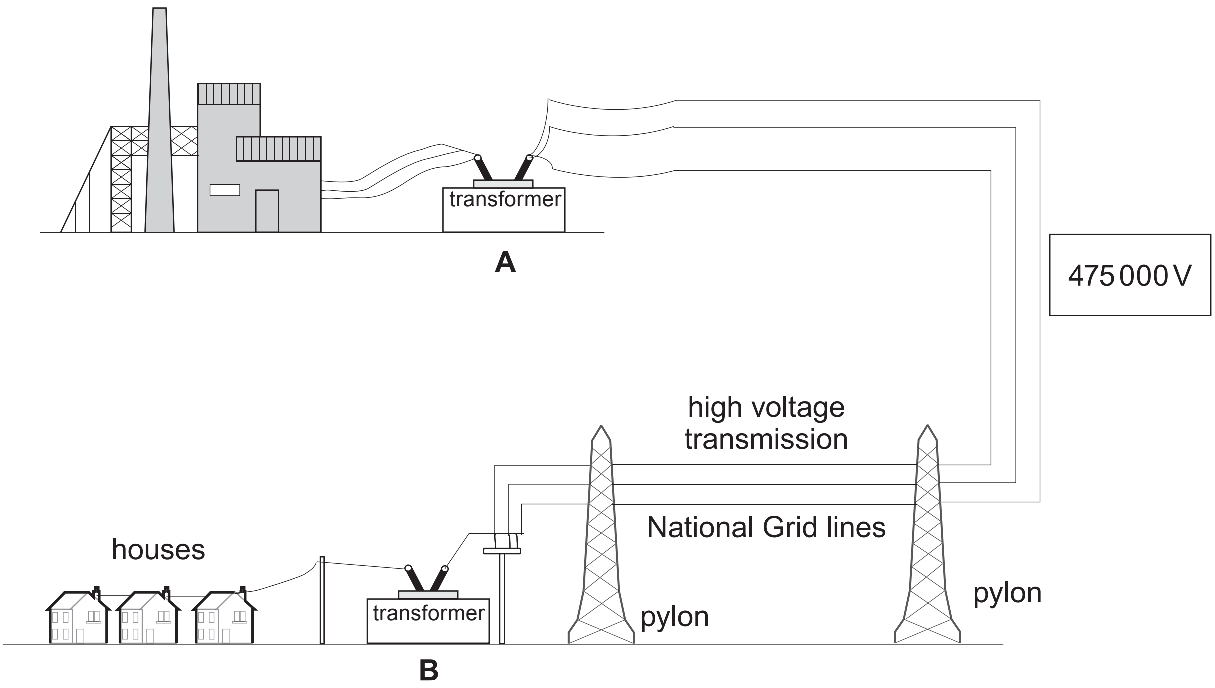
6. A diagram of the National Grid is shown below.



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

....

....

....

(b) Transformer **A** supplies 950 MW to the National Grid at 475 000 V.
Write down the input power to the National Grid in watts. [1]

power = ... W

(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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END OF PAPER