Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4463/02

SCIENCE A/PHYSICS

PHYSICS 1
HIGHER TIER

A.M. TUESDAY, 18 June 2013

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**12**	
2.	**17**	
3.	**6**	
4.	**11**	
5.	**7**	
6.	**7**	
Total	**60**	

4463
020001

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***(b)* and **6***(b)*.

Equations

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

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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Examiner only

Answer **all** *questions.*

1. Electricity is generated using many different sources.

(a) The table below shows the pollutant gases produced by burning fossil fuels to generate electricity.

Fossil fuel	Pollutant (unit)			
	Carbon monoxide	Carbon dioxide	Sulfur dioxide	Nitrous oxide
Coal	90	94 600	765	292
Oil	16	77 400	1 350	195
Gas	15	56 100	1	93

Use information in the table above to answer the following questions.

(i) Explain which fossil fuel will have the least impact on global warming. [2]

.....

.....

(ii) Explain which fossil fuel will cause the least acid rain. [2]

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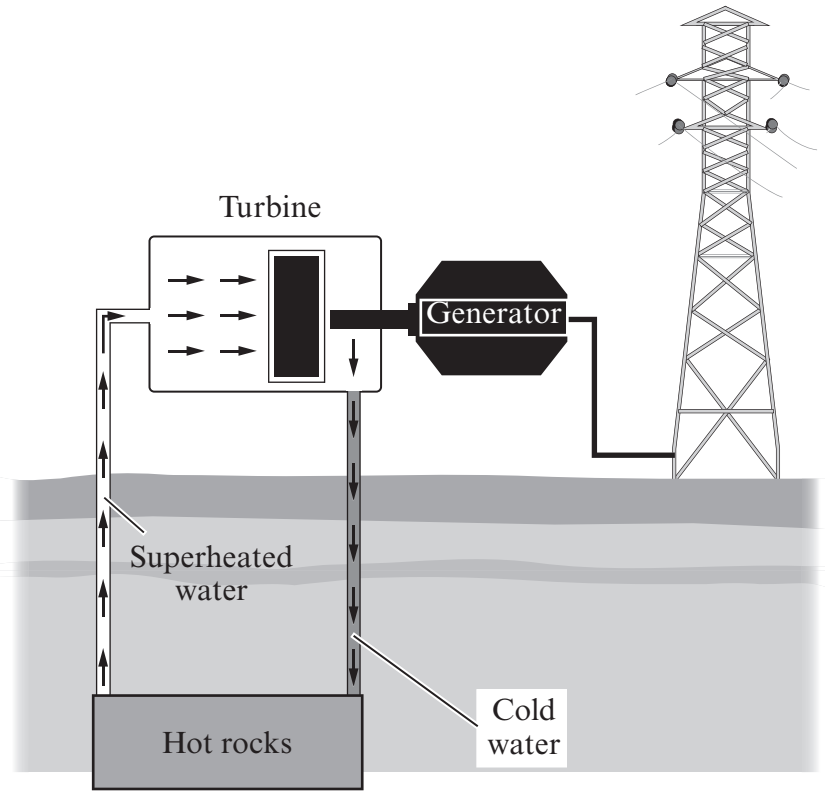
.....

Examiner only

(b) Plans have been revealed for what will be the first geothermal power station to be built in the UK. A 3 MW geothermal power station will be built at the Eden Project in Cornwall.

Cold water will be pumped down to hot rocks where its temperature will reach 150 °C. The superheated water will then be pumped back up, turn to steam, and turn turbines at ground level where electricity will be generated.



(i) This power station is similar to fossil fuel power stations because both types have turbines and generators. State **one** *other* way they are similar. [1]

.....

(ii) Give **one** advantage of geothermal power compared with solar power. [1]

.....

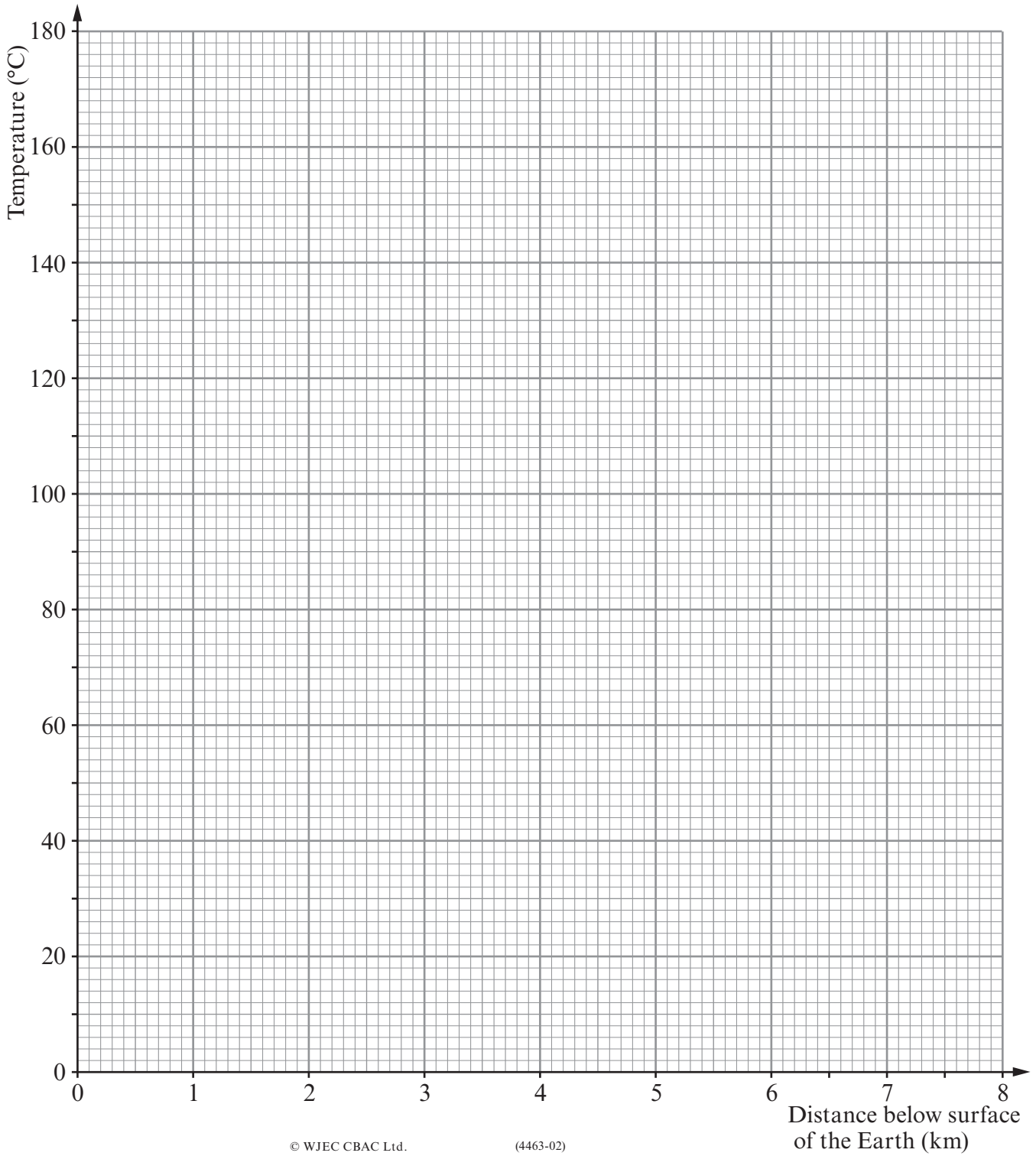
Turn over.

(c) The table below shows the temperature at different distances below the surface of the Earth.

Examiner only

Distance below surface of the Earth (km)	Temperature (°C)
1	40
2	60
4	100
6	140
8	180

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



Examiner only

(ii) Use the graph to find the distance water will have to be pumped down to reach 150 °C. [1]

distance = ... km

(d) This power station will provide 2.4 MW (2 400 000 W) for supplying homes. Calculate how many homes this power station could supply. Assume each home uses 2000 W of power. [2]

number of homes = ...

12

Turn over.

Examiner only

2. A semi-detached house is poorly insulated.
The owner has £3 200 available to spend on improving the insulation.
Information on each type of insulation is shown in the table below.

Part of house	Insulated or not	Heat energy lost per second (W)	Cost of insulation (£)	Payback time (years)	Expected annual saving (£)
LOFT	No insulation	4 200			
	Fibre glass laid on floor of loft	1 500	800	.....	200
CAVITY WALL	No insulation	3 000			
	Insulated with foam	1 300	1 200	10	120
DOORS	Wood	1 200			
	PVCu	1 000	1 200	60	.....
WINDOWS	Single glazed	1 500			
	Double glazed	1 200	2 400	96	25

(a) Complete the spaces in the last **two** columns of the table. [2]

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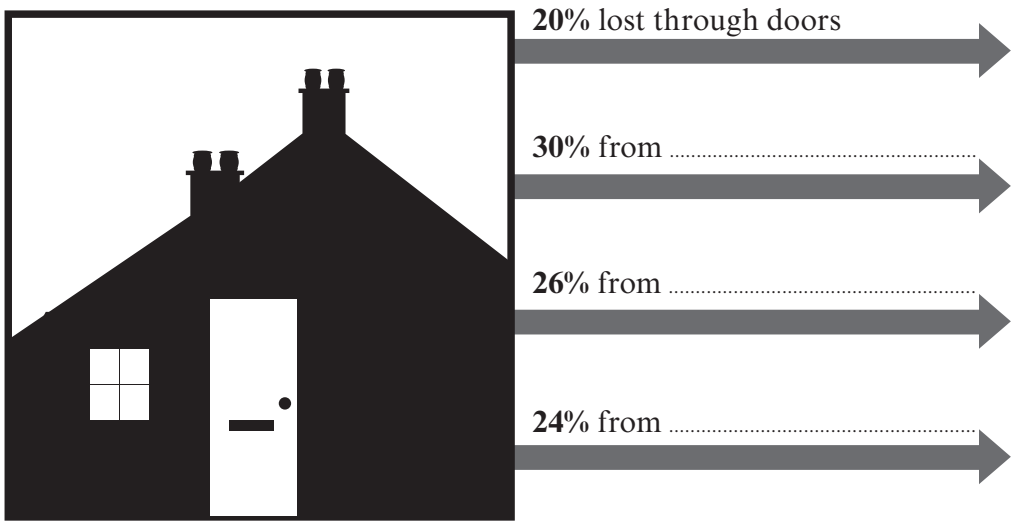
(b) Use information from the table opposite to advise the owner on how best to spend all the £3 200 on insulation. **[6 QWC]**

Turn over.

Examiner only

(c) The diagram shows the percentages of energy lost from the house if it is **fully insulated**. Label the arrows to show which part of the house each percentage comes from. *One has been done for you*. You should refer to the table on page 8. [2]



(d) Explain how convection currents are set up in a cavity wall with no insulation. [2]

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(e) The family in the house is advised to reduce the temperature in the main living area in winter time to save money. Explain how this would increase the payback time for the improvements that are undertaken. [2]

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(f) Insulating the cavity wall reduces the energy loss per second by 1 700 W. Use this information to calculate the time taken to save £120. One unit of electricity costs 15 p. [3]

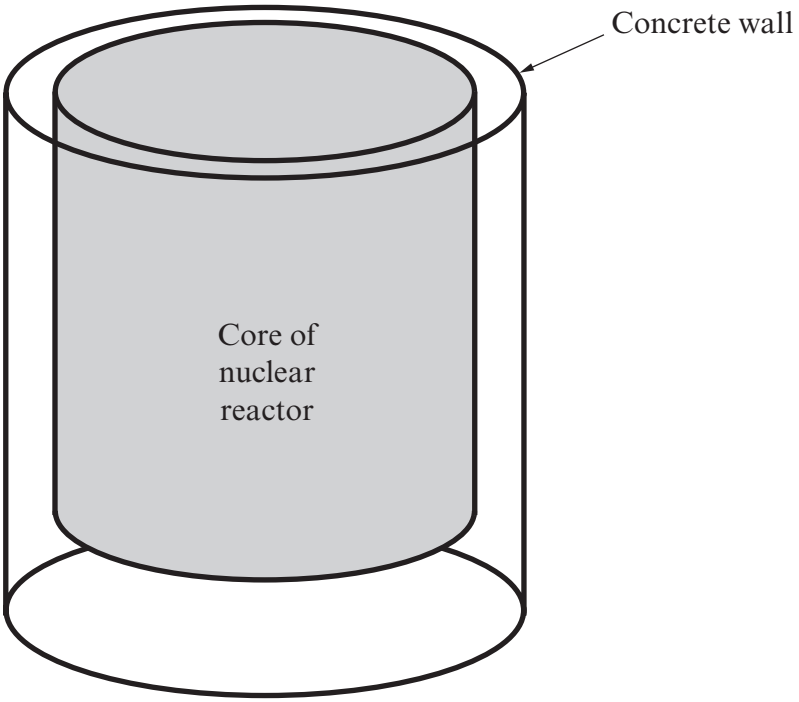
You should use the following equations:

$$\text{Units saved} = \frac{\text{saving}}{\text{cost per unit}} \qquad \text{Time (h)} = \frac{\text{units saved}}{\text{power (kW)}}$$

Time = ... hours

Examiner only

3. The core of a nuclear reactor is shielded by concrete.



(a) Compare the effectiveness of different thicknesses of concrete in absorbing each of the three types of radiation. [3]

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(b) (i) State **one** method for the long term storage of radioactive waste. [1]

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(ii) Outline **one** advantage and **one** disadvantage of storing the waste in this way. [2]

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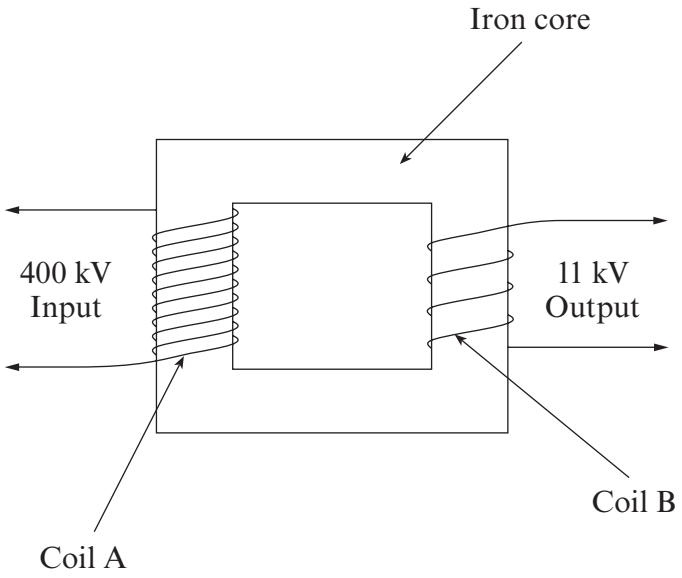
6

Turn over.

Examiner only

4. The diagram shows a transformer that is made up of two coils and an iron core. Transformers are used in the supply of electricity to homes, schools and industry. The one shown below has an input power of 10 MW and is 99% efficient.



(a) (i) Describe the National Grid. [2]

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(ii) Explain why electrical power is transmitted at high voltages in the National Grid. [2]

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(b) (i) Name the type of transformer shown in the above diagram and give a reason for your answer. [1]

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Examiner only

(ii) Use an equation from page 2 to calculate the current in the input coil. [3]

input current = ... A

(iii) Use the equation:

$$\% \text{ efficiency} = \frac{\text{useful power transfer}}{\text{total power input}} \times 100$$

to calculate the power delivered to the output coil and give its unit. [3]

output power = ... unit =.....

11

Examiner only

5. *(a)* In answer to a question about geosynchronous satellites, a candidate wrote:
"A geosynchronous satellite *stays in the same place in space* and *orbits the Earth in the same time as Earth orbits."*
The answer earned zero marks. Re-write the answer in the space below, correcting the parts in italics. [2]

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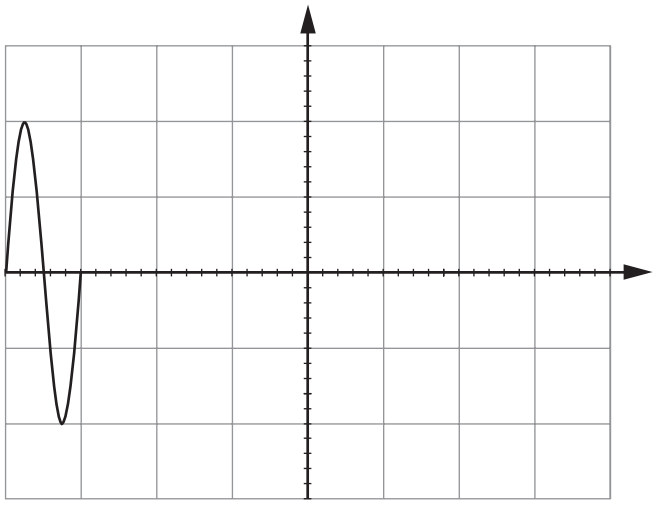
(b) When a geosynchronous satellite is placed in orbit around the Earth, it is tested by sending a pulse of electromagnetic radiation to it.

A **weaker** pulse is received back on Earth a short time later. The sent pulse is shown on the C.R.O. grid below.

Horizontal scale = 0.1 s/cm
Vertical scale = 0.2 V/cm

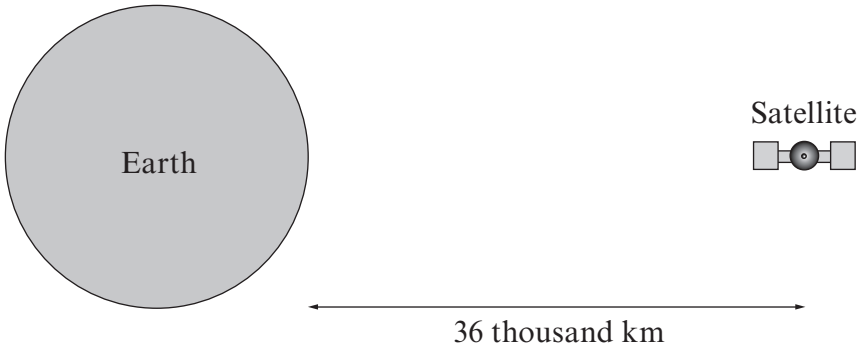


Examiner only

(i) Calculate the amplitude of the sent pulse. [2]

..... V

(ii) The height above Earth of a geostationary satellite is 36 thousand km.



It takes 0.12 s for a microwave signal to travel 36 thousand km.
State why it takes 0.24 s for the signal to be received back at the station. [1]

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(iii) **Draw** the received pulse on the C.R.O. grid on the opposite page. [2]

7

TURN OVER FOR QUESTION 6

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6. *(a)* The nearest star to our solar system is called Proxima Centauri. It is about 4 light years away. State what the term "4 light years" means. [1]

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(b) The spectrum of light coming from galaxies is crossed with dark lines.

Explain how the dark lines arise on the spectrum and outline the information that they give about those galaxies. [6 QWC]

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7

END OF PAPER