Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4463/02

SCIENCE A/PHYSICS

PHYSICS 1
HIGHER TIER

P.M. THURSDAY, 16 January 2014

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**12**	
2.	**12**	
3.	**10**	
4.	**8**	
5.	**5**	
6.	**7**	
7.	**6**	
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 **7**.

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Equations

density = $\dfrac{\text{mass}}{\text{volume}}$	$\rho = \dfrac{m}{V}$
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 = $\dfrac{\text{useful energy [or power] transfer}}{\text{total energy [or power] input}} \times 100$	
wave speed = wavelength × frequency	$c = \lambda f$
speed = $\dfrac{\text{distance}}{\text{time}}$	

SI multipliers

Prefix	Multiplier
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. There is an increasing demand for electricity but the reserves of fossil fuels are decreasing.

(a) A way to meet increasing demand for electricity is to build nuclear power stations.

(i) Give **two** reasons to support building more nuclear power stations than other types in the future. [2]

1. ....

2. ....

(ii) Nuclear waste is a problem that must be dealt with. One possible solution would be to bury the waste deep underground. State **one** disadvantage of burying nuclear waste. [1]

....

(b) Electricity can also be generated using bio-fuels such as woodchip and straw. Plants for bio-fuels use carbon dioxide from the air as they grow. Explain why burning bio-fuels is more environmentally friendly than burning fossil fuels. [2]

....

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....

(c) The table below shows typical crop yields and the energy content of some bio-fuels.

Crop	Crop yield in a year from each km^2 of land (tonnes)	Energy content (units/tonne)
poplar	8	18
willow	10	20
grass	5	16

(i) Which crop would be the worst choice for using as a bio-fuel? .... [1]

Give **two** reasons for your answer. [2]

1. ....

2. ....

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(ii) A 10 MW power station needs 50 000 tonnes of willow crop a year.

I. Calculate the area of land needed to grow this amount of willow crop. [1]

Area .... km^2

II. Calculate the energy content of 50 000 tonnes of willow crop. [1]

Energy content = ... units

(iii) An area of 2 km^2 of land is needed to produce 10 MW using wind turbines. Explain why this method of generating electricity is more environmentally friendly than using bio-fuels. [2]

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12

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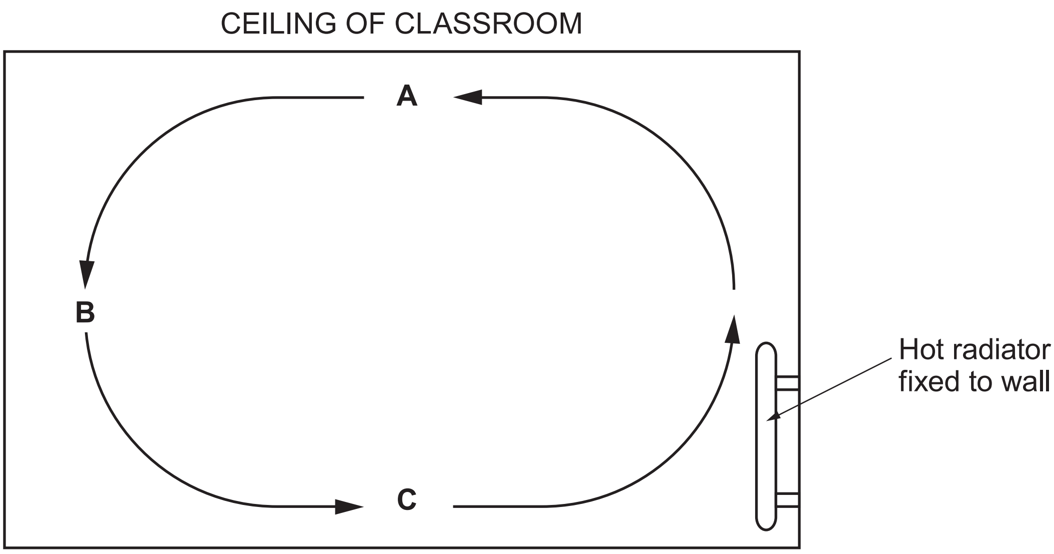
2. *(a)* A classroom has a volume of 80 m^3 and contains 104 kg of air. Use an equation from page 2 to calculate the density of the air in the room and state the unit. [3]

Density = ...

Unit ....

(b) The classroom is now heated by a radiator. This sets up a convection current in the air as shown in the diagram below.



(i) At which point **A, B** or **C** is the air in the classroom the hottest? .... [1]

(ii) At which point **A, B** or **C** is the air in the classroom least dense? .... [1]

(iii) Give a reason for your answer to *(b)*(ii). [1]

....

....

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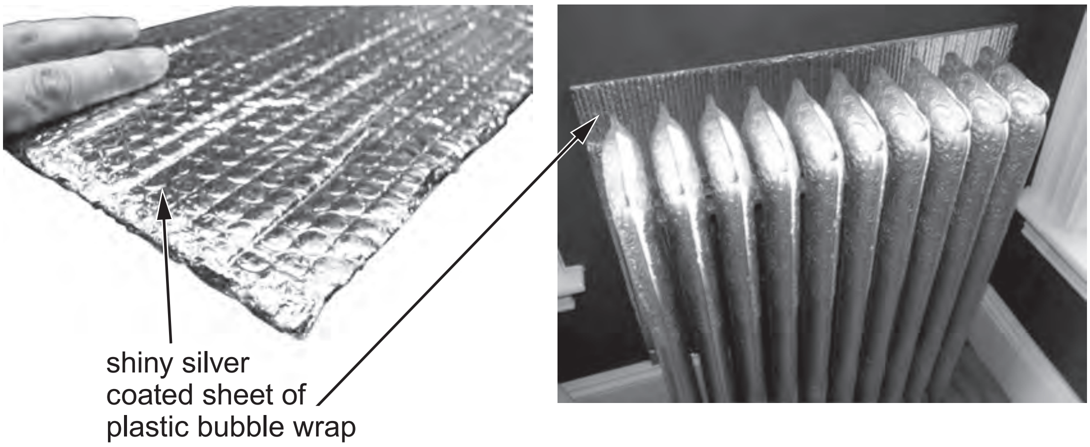
(c) A shiny silver coated sheet of plastic bubble wrap is placed on the wall behind the radiator. Explain how this can reduce heat loss from the classroom by conduction, convection and radiation. [6 QWC]



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3. Waves can travel across the surface of water. Their speed depends upon the depth of the water.
Water is placed into a plastic tray. The depth of water is measured.
Some pupils time how long it takes a wave to travel 4 **lengths** of the tray.
They repeat the timing for each depth of water.
Here are the results obtained from their experiment.

Depth of water (cm)	Time taken 1 (s)	Time taken 2 (s)	Mean time (s)	Wave speed (cm/s)
0				0
0.5	3.2	2.8	3.0	30
1.0	2.0	2.2	2.1	43
1.5	1.7	1.7	1.7	53
2.0	1.6	1.4	1.5	60
3.0	1.4	1.2	....	69

(a) Complete the table to show the missing mean time at a water depth of 3.0 cm. [1]

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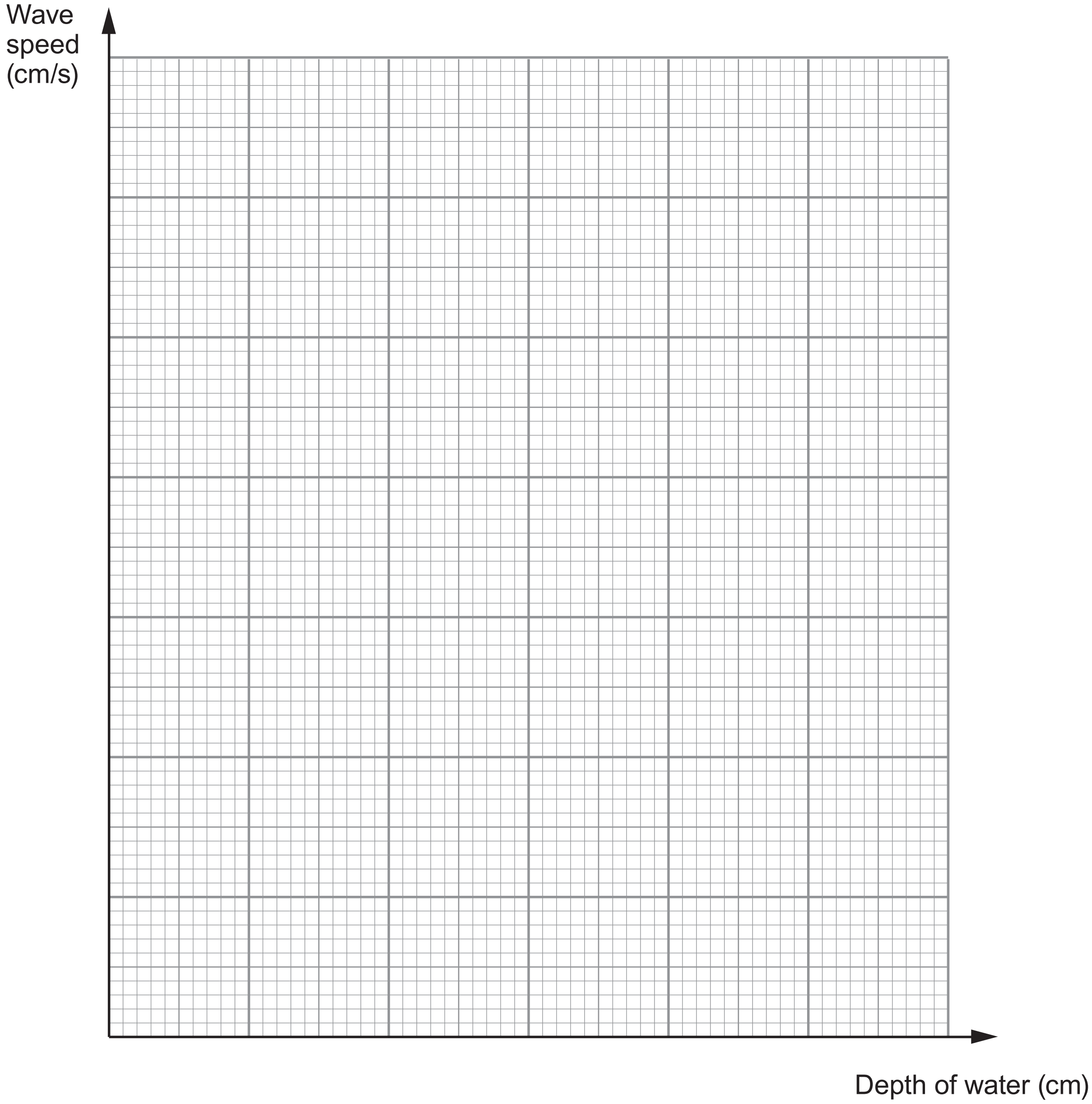
(b) (i) Plot the data on the grid below and draw a suitable line to show how the wave speed depends upon the depth of water. [3]



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

....

....

(iii) Use the graph to find the wave speed for water that has a depth of 2.5 cm. [1]

Wave speed .... cm/s

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(c) Using data from the table and an equation from page 2, calculate the length of the plastic tray. [3]

Length = ... cm

10

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4. The table below shows how the electrical demand in the UK during one evening in the winter is met by suppliers.

Origin	Power (MW)
UK	41 758
Transferred in from France	996
Transferred in from Netherlands	992
Transferred in from Ireland	254

(i) The efficiency of transmission along the National Grid is approximately 90%. Use an equation from page 2 to calculate the power consumption of users. [3]

Power = ... MW

(ii) Explain how the National Grid is designed to provide such a high transmission efficiency. [2]

....

....

....

(iii) There are electrical supply lines between the UK and northern France. The undersea section consists of eight 46 km long, 270 kV cables in parallel, between Folkestone (UK) and Sangatte (France). Assuming the power is **shared equally** between these 8 cables, use an equation from page 2 to calculate the current through each cable during the evening referred to above. [3]

Current =................................ A

8

5. A list of radioisotopes and their decay mode is shown in the table below.

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Radioisotope	Decay mode
Radon - 272	α
Strontium - 90	β
Silver - 110	β and γ
Iodine - 131	γ
Radium - 226	α and γ

The table below shows the count rate detected from three of the radioisotopes above when different absorbers are placed between the source and counter. The distance between the counter and the radioisotope is fixed at 2 cm.

Radioisotope	Count rate (units)			
	No absorber	Paper	Aluminium	Lead
X	21	20	21	6
Y	74	73	56	15
Z	44	32	33	12

Use the information in **both** tables to identify radioisotopes **X, Y** and **Z** giving your reasoning. [5]

Radioisotope **X** is ....

Reasoning:

....

....

....

Radioisotope **Y** is ....

Reasoning:

....

....

....

Radioisotope **Z** is ....

Reasoning:

....

....

....

5

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6. *(a)* An incomplete diagram of the electromagnetic (em) spectrum is shown below.

(i) Complete the **first column** to show the missing ionising regions in order of decreasing frequency. [2]

Region of em spectrum	Wavelength range (m)
Gamma rays	....
....	....
....	....
Visible light	....

(ii) Typical wavelength ranges for each region of the em spectrum in metres are listed below in a random order.

4×10^{-7} to 7×10^{-7}	$< 1 \times 10^{-11}$	1×10^{-9} to 4×10^{-7}	1×10^{-11} to 1×10^{-9}

Use these values to **complete** the wavelength column in the table above. [2]

(b) One ionising region of the em spectrum has wavelengths in the range 4×10^{-7} to 1×10^{-9} m. Use an equation from page 2 to calculate the maximum frequency of this region of the em spectrum. The wave speed of em waves is 3×10^{8} m/s. [3]

maximum frequency = ... Hz

7

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7. State what is meant by absorption spectra **and** explain how they can provide information about stars and galaxies. [6 QWC]

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6

END OF PAPER

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