Surname	Centre Number	Candidate Number
Other Names		0

WJEC CBAC

New GCSE

4463/02

SCIENCE A
HIGHER TIER
PHYSICS 1

P.M. THURSDAY, 17 January 2013

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**7**	
2.	**6**	
3.	**7**	
4.	**14**	
5.	**8**	
6.	**6**	
7.	**6**	
8.	**6**	
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 **4***(a)* and **8**.

Equations

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

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}

BLANK PAGE

4463
020003

Examiner only

Answer **all** *questions.*

1. The following table gives information about 4 metals that may be used in overhead cables in the National Grid.

Metal	Strength of cable (units)	Ability to conduct electricity (units)	Density (kg/m^3)
Copper	250	600	8 950
Steel	800 to 2 000	10	7 900
Aluminium	220	35	2 700
Lead	10	5	11 300

(a) Use only the information in the table above to answer the following questions.

(i) Give **one** reason why copper is usually the best metal to use for electrical wires.[1]

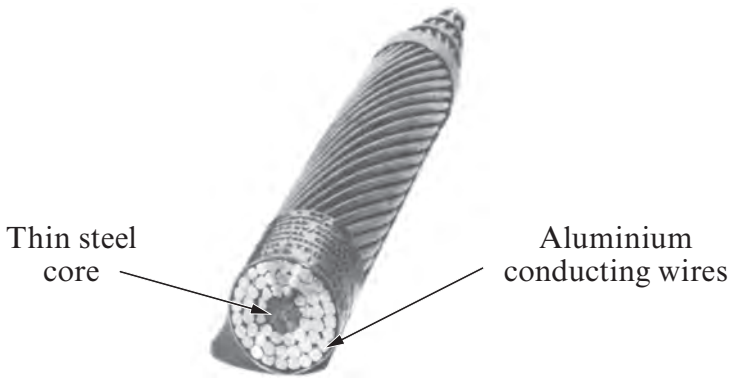
.....

(ii) Name the metal that would be most unsuitable for overhead cables. [1]

.....

Examiner only

(iii) Explain why actual overhead cables are made from a thin steel core surrounded by aluminium conducting wires. [3]



.....

.....

.....

.....

.....

(b) The aluminium used in a 100 m length of cable has a volume of 0.12 m^3. Use the equation

mass = density × volume

and information from the table on the opposite page to calculate the mass of aluminium in this cable. [2]

mass = ... kg

7

Examiner only

2. Read the following passage.

Its official now! Radiation from your mobile phone may be killing you.

(Freely adapted from an article from EMRstop.org)

Source: DNA India

Professor Kumar, of Bombay University has done extensive research on mobile phone radiation and its effects.

The major health hazards of non-ionising radiation from mobile phones and masts are given below.

Excessive use of mobile phones can cause cancer. Use of mobile phones for more than 30 minutes per day for 10 years increases the risk of brain cancer.

There is a 400% increase in the risk of brain cancer among teenagers using mobile phones. The younger the child, the deeper the penetration of electromagnetic radiation because the skull is thinner.

Mobile phone radiation causes irreversible damage to male fertility. Studies have found a 30% lower sperm count in intensive male users of mobile phones.

People who often use mobile phones can suffer damage to their vision. Mobile phones that work at 900 and 1 800 MHz have outputs of 0.25 W and 0.125 W respectively and increase the temperature within the eye by 0.1 °C.

Exposure to electromagnetic waves can cause sleep disorders.

(a) Use information in the passage to answer the following questions.

(i) Give **one** frequency at which mobile phones operate. ..... [1]

(ii) It is suggested that the output power is directly proportional to the frequency of mobile phones.
Use evidence from the passage to show whether or not this is correct. [2]

.....

.....

.....

.....

Examiner only

(iii) Explain what needs to be done for the claims in the passage to be accepted by the wider scientific community. [2]

.....

.....

.....

(b) Name the region of the electromagnetic spectrum used by mobile phones to communicate with their masts. [1]

.....

6

Examiner only

3. *(a)* Describe the National Grid. [2]

.....

.....

.....

.....

(b) The picture shows a transformer that supplies electricity to consumers from the National Grid.

(i) Explain the purpose of this transformer. [2]

.....

.....

(ii) Use an equation from page 2 to calculate the current drawn from the transformer when the output power is 0.46 MW and the voltage is 230 V. [3]

current = ... A

7

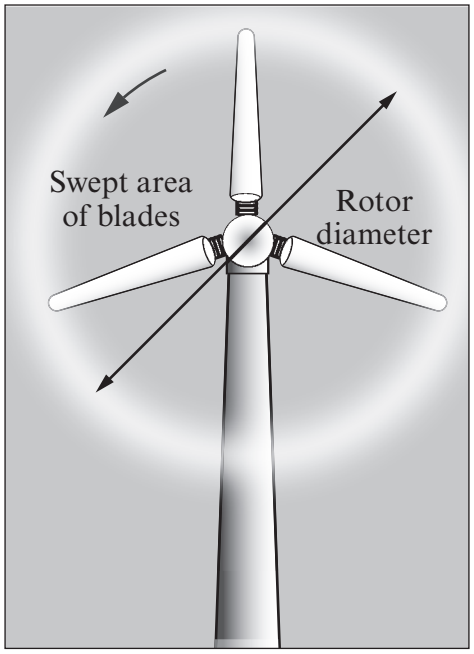
Examiner only

4. The table below gives information about generating electricity from wind and nuclear power.

How they compare		
	A wind turbine	A nuclear power station
Overall cost of generating electricity (p/kWh)	5.6	2.8
Maximum power output (MW)	2	3600
Lifetime (years)	15	45
Waste produced	None	Radioactive waste
Lifetime carbon footprint (g of CO_2/kWh)	4.64/5.25 (onshore/offshore)	5
Commissioning cost (£ million)	3	4000

(a) Use your knowledge and information from the table to **compare** the **cost-effectiveness** and **environmental** impact of the two methods of generating electricity. [6 QWC]

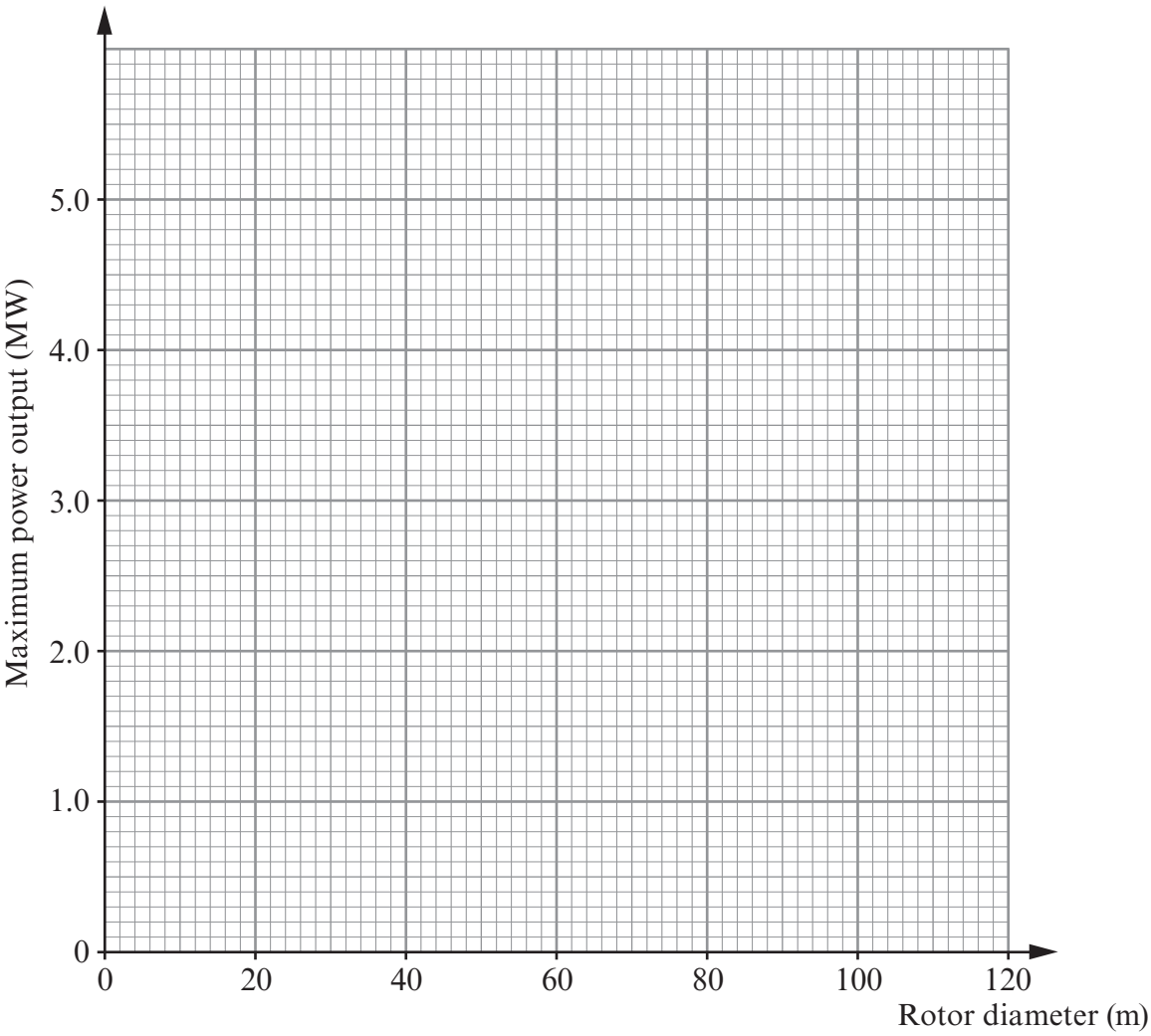
(b) The maximum power output from a wind turbine depends on the rotor diameter as shown in the table.



Rotor diameter (m)	Maximum power output (MW)
40	0.5
60	1.1
80	2.0
90	3.0
110	4.5

Examiner only

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



(ii) Describe the relationship between rotor diameter and maximum power output. [2]

.....

.....

.....

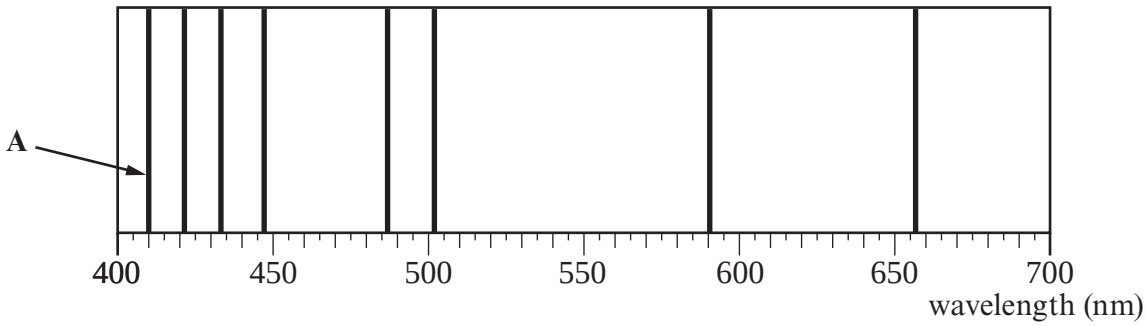
(c) A wind turbine, of rotor diameter 90 m, operates with an efficiency of 60%. Use an equation from page 2 to calculate the input power from the wind which produces the maximum power output. [3]

input power = ... MW

14

Examiner only

5. The diagram shows a spectrum from a star. The spectrum is crossed by dark lines. Astronomers use this information to determine which elements make up the star.



(a) Identify the elements present in the star by putting a **Y** (yes) or **N** (no) in the last column of each row in the table below. [2]

Element	Wavelengths (nm)	Present in star?
Helium	447, 502	.....
Iron	431, 467, 496, 527	.....
Hydrogen	410, 434, 486, 656	.....
Sodium	590	.....

(b) Electromagnetic waves travel at a speed of 3×10^8 m/s through space.

(i) Use an equation from page 2 to calculate the frequency at which the dark line labelled **A** appears. (1 nm = 1×10^{-9} m.) [3]

frequency = ... Hz

(ii) The spectrum is from a star that is 8.6 light years away. Use an equation from page 2 to convert this distance to metres. (1 year = 3.2×10^7 s.) [3]

distance = ... m

8

Examiner only

6. Brachytherapy is a type of internal radiotherapy, which involves putting a solid radioactive material close to, or inside, the cancerous growth. The radioisotope used emits low energy gamma rays. This is different from external radiotherapy which is normally given as a series of short, daily treatments in the radiotherapy department using high energy gamma rays.

(i) Explain why alpha sources are unsuitable for **both** types of radiotherapy treatments described above to be effective. [2]

.....

.....

.....

(ii) Suggest why the gamma rays used in brachytherapy are low energy compared to those used in external gamma radiotherapy. [2]

.....

.....

.....

(iii) Explain why gamma rays are used to treat cancer tumours. [2]

.....

.....

.....

6

Examiner only

7. The table shows the heat lost per second through parts of a house. The temperature inside the house is 20 °C and the outside temperature is 9 °C.

Part of house	Insulation	Heat energy lost per second (J)
ATTIC	None	3 000
	Fibre glass laid on floor of attic	400
CAVITY WALL	None	2 000
	Insulated with foam	700
WINDOWS	Single glazed	2 000
	Double glazed	1 200

(a) (i) Find the total energy lost per second from the house if the attic and cavity wall are insulated and it has single glazed windows. [1]

energy loss per second = ... J

(ii) Use your answer to *(a)*(i) to write down the power (in kW) needed to keep the temperature of the house at 20 °C. [1]

power = ... kW

(iii) The power calculated in *(a)*(ii) is provided by electrical heating. Use equations from page 2 to find the cost of keeping the temperature of the house constant at 20 °C for 10 hours. One unit of electricity costs 13 p. [2]

cost = ...

(b) Explain why the cost calculated above would be different if the temperature outside the house dropped to 5 °C during this time. [2]

.....

.....

.....

.....

6

Examiner only

8. Explain what is meant by the term 'cosmological red shift' **and** how it provides evidence for the origin of the Universe. [6 QWC]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

6

END OF PAPER