Candidate Name	Centre Number	Candidate Number

WJEC CBAC

GCSE

237/02

SCIENCE
HIGHER TIER
PHYSICS 1

A.M. WEDNESDAY, 20 January 2010

45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark awarded**
1.	**7**	
2.	**5**	
3.	**7**	
4.	**5**	
5.	**7**	
6.	**11**	
7.	**8**	
Total	**50**	

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator.

INSTRUCTIONS TO CANDIDATES

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.

EQUATIONS

power = voltage × current

energy transfer = power × time

units used (kWh) = power (kW) × time (h)

cost = units used × cost per unit

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

wave speed = wavelength × frequency

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

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Answer **all** *questions*.

1. **Read** the passage below and answer the questions that follow.

In 1895, W.C. Röntgen discovered rays capable of passing through the human body. Because of their unknown nature, he called them X-rays.

He noticed that, whenever he made electrical sparks in a vacuum tube, a fluorescent screen at the other end of the laboratory table glowed. Invisible rays were being produced in the vacuum tube, crossing the room and striking the screen, producing the glow. He tried to block the rays with thin metal sheets but they were transparent to the rays.

He moved a piece of lead near to the screen, and dropped it in surprise when he saw the skeleton pattern of the bones in his hand on the screen.

Adapted from http://nobelprize.org/educational_games/physics/x-rays/how-1.html

(a) (i) How did Röntgen produce the rays in the tube? [1]

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(ii) How did Röntgen know that these rays were being produced? [1]

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(iii) Give **one** reason why thin sheets of metal did not produce a shadow when placed in front of the tube. [1]

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(b) Until 1955, children's feet were X-rayed in shoe shops to check that their shoes fitted properly.
Explain why it was decided that this was unsafe. [2]

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Examiner only

(c) Röntgen's discovery of X-rays was not accepted at first by other scientists. Describe **two** further steps needed before they would accept his discovery. [2]

1. .....

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2. .....

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7

Turn over.

Examiner only

2. The table shows some of the information planners use to help them decide on the type of power station they will allow to be built.

How they compare		
	Wind	Nuclear
Overall cost of generating electricity (p / kWh)	5.4p	2.8p
Maximum power output (MW)	3.5	3600
Lifetime	15 years	50 years
Waste produced	none	Radioactive substances, some remain dangerous for thousands of years
Lifetime carbon footprint (g of CO_2 / kWh)	4.64g / 5.25g (onshore/offshore)	5 g

Adapted from *www.guardian.co.uk*

Use the information in the table to answer the questions.

(i) Give **one** reason why the information in the table does **not** agree with the idea that wind power will be a cheaper method of producing electricity. [1]

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(ii) Supporters of wind power argue that it will reduce global warming more than nuclear power.
Explain whether this is supported by information in the table. [2]

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(iii) Supporters of nuclear power argue that it will meet a greater demand for electricity in the future than wind power.
Give **two** ways in which this is supported by information in the table. [2]

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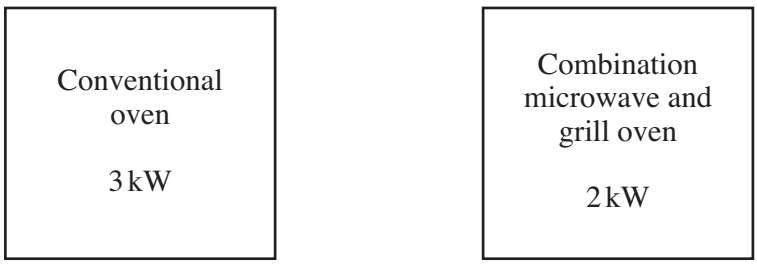
3. Electrical stores sell different types of ovens.
Two types are shown below together with their power ratings.



A chicken is cooked in the combination microwave and grill oven.
It takes 0.75 hours to cook.

(i) Write down an equation as it appears on page 2 and use it to calculate the units used by this combination oven in kilowatt hours.

Equation: .....

..... [1]

Calculation: [2]

Units used = ... kWh

(ii) 1 unit of electricity costs 12p.
Write down an equation as it appears on page 2 and use it to find the cost of using the combination oven to cook the chicken.

Equation: .....

..... [1]

Calculation: [1]

cost = ... p

(iii) The same chicken could have been cooked in the conventional oven in 1.5 hours.
Explain why this would cost more. [2]

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Examiner only

4. *(a)* The table gives information about some ways of reducing energy costs in a house.

Method used to reduce energy costs	Cost (£)	Saving per year (£)
Fitting thermostats to every radiator	80	20
Fitting a new hot water boiler	1600	200
Fitting solar panels for water heating	2700	250
Fitting double glazed windows	3600	90

Compare the cost-effectiveness over 10 years of fitting a new boiler with fitting solar panels. You should support your answer with calculations. [3]

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(b) One benefit of reducing our energy consumption is less pollution of the atmosphere. Describe **two** other environmental benefits of reducing energy consumption. [2]

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2. .....

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5

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5. *(a)* During their life cycles, the chemical composition of stars changes.

(i) Explain why the amount of hydrogen in a star decreases over time. [2]

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(ii) In what other ways does a star's composition change as it ages? [2]

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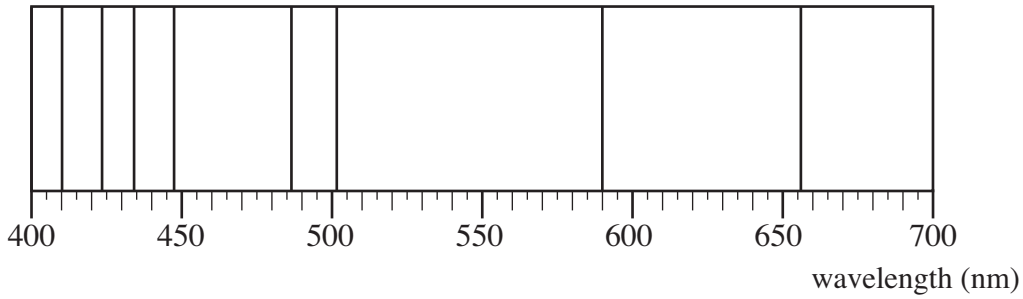
(b) (i) The diagram shows dark lines seen on the visible spectrum of a star.



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. [1]

Element	Wavelengths (nm)	Present in the star?
helium	447, 502	
iron	431, 467, 496, 527	
hydrogen	410, 434, 486, 656	
sodium	590	

(ii) Explain how and why these dark lines would appear in different positions in the spectrum of a star in a distant galaxy. [2]

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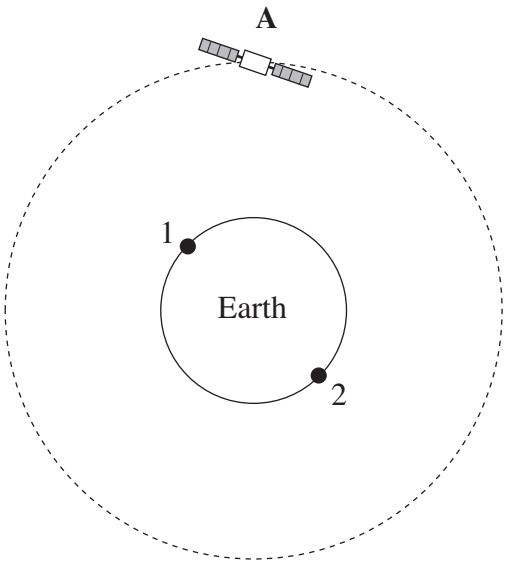
6. The diagram shows a communications satellite **A** in geosynchronous (geostationary) orbit around the Earth. The diagram is not to scale.



(a) (i) Explain the advantages of placing communications satellites in geosynchronous orbit. [2]

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(ii) **Add to the diagram** another satellite **B** that will enable radio station **1** to communicate with radio station **2**.

(iii) **Show on the diagram** the path taken by the signal, via the satellites **A** and **B**, when radio station **1** communicates with radio station **2**. [3]

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(b) (i) Communications between geosynchronous satellites and Earth are made using microwaves of wavelength 20 cm that travel at 3×10^8 m/s.

Write down an equation as it appears on page 2 and use it to calculate the frequency of the microwaves.

Equation: .....

..... [1]

Calculation: [2]

Frequency = ... Hz

(ii) The time delay between sending a signal from **1** and its reception at **2** is 0.48s.

Use the equation

$$\text{Speed} = \frac{\text{distance}}{\text{time}}$$

to find the approximate height of geostationary satellites above the Earth. [3]

Height above Earth = ...

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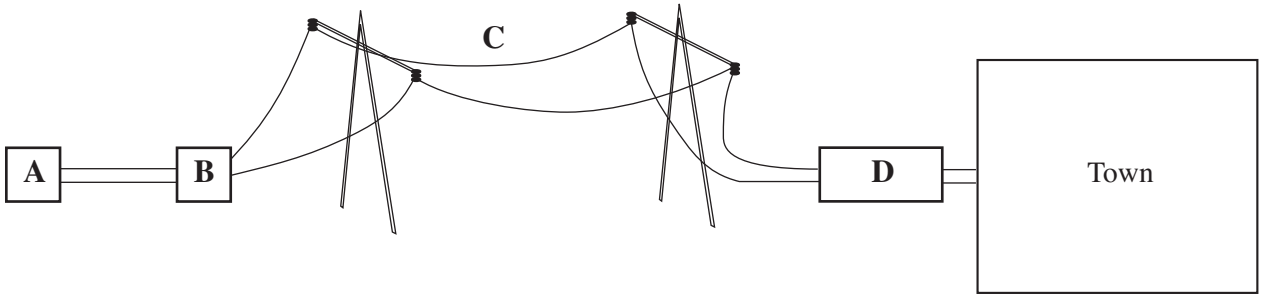
7. The diagram shows part of the national grid system. **A** is a power station, **B** and **D** are transformers. The diagram is not to scale.



(i) Explain the purpose of transformers **B** and **D** in the national grid system. [3]

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(ii) The power requirement of the town is 100 MW. The overall efficiency of the national grid is 92%.
Use the equation

$$\text{Efficiency} = \frac{\text{Useful power output}}{\text{Total power input}} \times 100$$

to calculate the power that the power station needs to generate to supply the town. [2]

Power = ...

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(iii) Assume that electricity is transmitted along the cables **C** at a power of 100 MW and a voltage of 400 kV.

Use the equation

$$\text{Power} = \text{voltage} \times \text{current}$$

to calculate the current in the cables. [3]

Current = ...

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