WJEC CBAC

GCSE

237/02

SCIENCE
HIGHER TIER
PHYSICS 1

P.M. FRIDAY, 17 June 2011

45 minutes

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.

EQUATIONS

power $=$ voltage $\times$ current

energy transfer $=$ power $\times$ time

units used (kWh) $=$ power (kW) $\times$ time (h)

cost $=$ units used $\times$ cost per unit

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

wave speed $=$ wavelength $\times$ frequency

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

Commonly used prefixes			
Multiplier	Symbol	Meaning	
micro	μ	0.000 001	10^{-6}
milli	m	0.001	10^{-3}
centi	c	0.01	10^{-2}
kilo	k	1 000	10^{3}
mega	M	1 000 000	10^{6}
giga	G	1 000 000 000	10^{9}

*Answer **all** questions.*

1. *(a)* A wind turbine that is designed to produce 2 000 kW only produces 600 kW on average. Give a reason why. [1]

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(b) On a particular day the wind power input to a wind turbine is 1 500 kW. The turbine produces 900 kW of electrical power.

Select an equation from page 2 and use it to calculate the efficiency of the wind turbine.

Equation: ....

.... [1]

Calculation: [2]

Efficiency = ...

(c) Fossil-fuelled power stations release 430 grams of carbon dioxide (CO_2) for each unit (kWh) of electricity produced, but wind turbines release none whilst they are working.

(i) Give a reason why it is important to try to reduce the amount of CO_2 produced when generating electrical power. [1]

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(ii) Calculate the number of grams of CO_2 saved by generating 900 kW for one hour from wind rather than coal. [2]

Mass of CO_2 saved = ... g

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Turn over.

2. The table shows the heat energy lost per second through parts of a house.

Part of house	Insulated or not	Heat energy (J) lost per second
ATTIC	Non insulated	3 000
	Fibre glass laid on floor of attic	400
CAVITY WALL	Non insulated	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 **not** insulated and it has single glazed windows. [1]

Energy lost = ... J/s

(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 needed = ... kW

(iii) How much energy is saved per second by fitting double glazing? [1]

Energy saved = ... J/s

(b) Explain why insulating the attic benefits the environment more than the other **two** insulating measures. [2]

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(c) Explain why filling a cavity wall with foam reduces the heat lost through the walls. [2]

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(d) The householder is advised to reduce the temperature of the inside of the house to 19°C to reduce heating costs.
Explain the reasoning behind this advice. [2]

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3. A reflector on the back of a bicycle is made up of many glass prisms, one of which is shown in the diagram.
A ray of light strikes the back surface of the prism at point C at an angle of 45°.
The critical angle for glass is 42°.
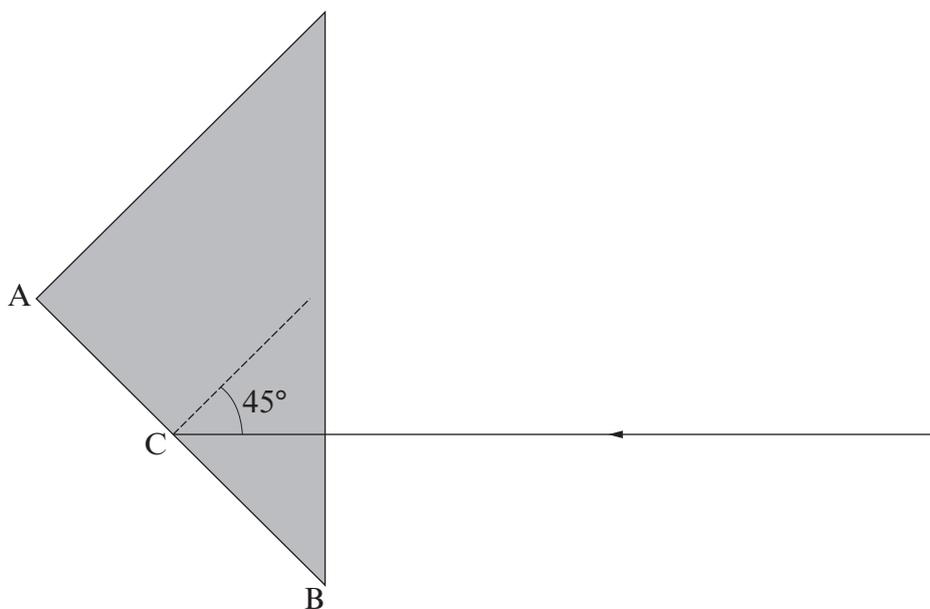
(a) (i) Explain why the light does not leave the prism at point C. [1]

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(ii) What is the name given to this effect? [1]

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(b) **Draw on the diagram** the path taken by the ray of light through the glass and into the air. [2]

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Turn over.

4. In 2005, a householder paid £500 a year for electricity and £720 for gas.
On January 1st 2006, he had solar panels put on the roof to provide hot water. The solar panels cost £2520.
In 2006, the householder's bill was £520 for electricity and £620 for gas.

(a) How can you tell from the information above that gas was used to heat water?   [1]

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(b) (i) By considering the saving on **total** energy for the house between these two years, calculate the expected payback period to cover the cost of the solar panels.   [3]

Saving = £ ....

Payback time = ... years

(ii) Name two factors that may cause the payback period to be shorter than you have calculated in *(b)*(i).   [2]

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(c) The electricity supplier charged £0.09 per unit for **electricity** throughout this period.

Calculate the number of **extra** units of electricity used in 2006.   [3]

Number of extra units = ...

5. Light from distant galaxies is "Red Shifted".
The light from some galaxies shows a greater red shift than light from others.

(a) (i) State what causes the light from distant galaxies to be red shifted. [1]

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(ii) Explain why some galaxies have a greater red shift than others. [2]

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(b) Explain how the observations and explanation of red shift led to the development of the Big Bang theory. [2]

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Turn over.

6. Geostationary artificial satellites are used to send messages and TV pictures around the world.

(a) Explain why a satellite in a geosynchronous orbit appears to stay in a fixed place above the surface of the Earth even though both the satellite and the Earth are constantly moving.
[3]

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(b) The diagram shows three satellites in geosynchronous orbit around the Earth.

Diagram not to scale.
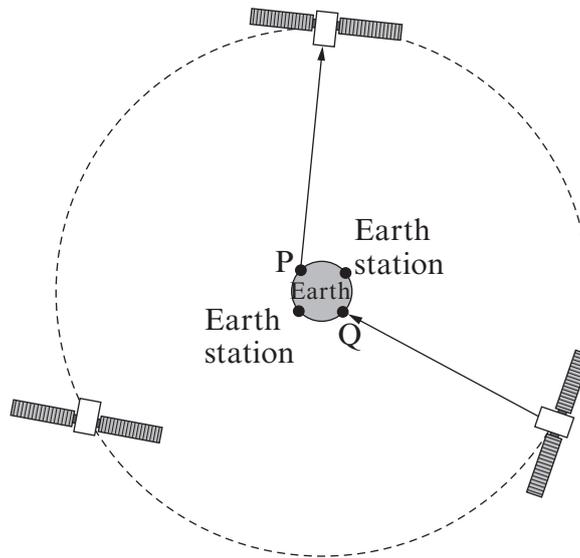
(i) A signal is to be sent from P to Q using the satellites.
Draw lines on the diagram to show the path taken by the signal. The **first** and **last** part of the path has been drawn for you. [1]

(ii) Select an equation from page 2 and use it to calculate the time lag of the signal between P and Q.
The height of a geosynchronous satellite above the Earth is 3.6×10^7m and the speed of the electromagnetic waves is 3×10^8m/s.

Equation ....

.... [1]

Calculation [3]

Time lag = ...

7. *(a)* Explain how the formation of the solar system resulted in the inner four planets being
solid and the outer four being gaseous. [4]

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(b) (i) State **two** differences between a comet and a planet. [2]

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(ii) Describe how a comet's tail is formed. [2]

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