Candidate Name	Centre Number	Candidate Number
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GCSE

237/02

SCIENCE
HIGHER TIER
PHYSICS 1

A.M. MONDAY, 19 January 2009

45 minutes

For Examiner's use only	
Total Mark	

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 of the examination paper. 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(kWh) × cost per unit

$$\text{cost per unit} = \frac{\text{cost}}{\text{units used (kWh)}}$$

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

wave speed = wavelength × frequency

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

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

Answer **all** *questions.*

1. *(a)* Diagram 1 shows the Sun (S) and the positions of the planets Earth (E), Mars (M) and Venus (V) on 1st June.
Diagram 2 shows their positions 6 months later.

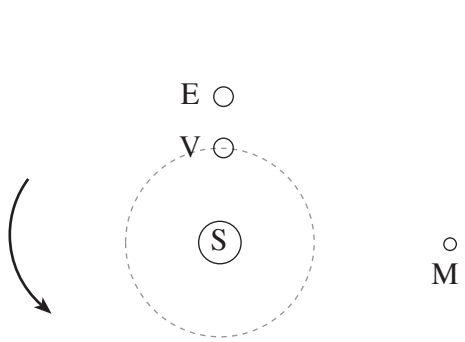

Diagram 1

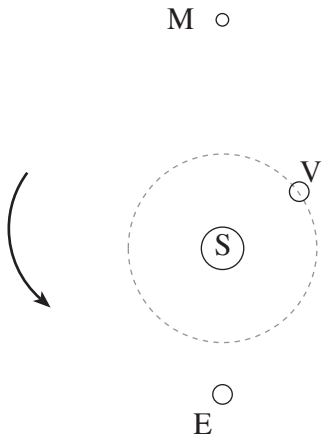

Diagram 2

Use the information above to answer the following questions.

(i) How long does it take Earth to orbit the Sun? ..... [1]

(ii) How long does it take Mars to orbit the Sun? ..... [1]

(iii) How can you tell that Venus orbits the Sun in less time than Earth? [1]

.....

.....

(b) Mars is further than Earth from the Sun. Give a reason why Mars takes longer than Earth to orbit the Sun. [1]

.....

.....

4

2. The following information plate is found on an oven that combines a microwave and a grill.

Voltage	230 V
Microwave power	0·8 kW
Grill power	1·2 kW

(i) Name the **two types** of electromagnetic radiation that the oven uses to cook food. [2]

....

(ii) A large joint of meat is cooked using **both** microwave and grill at full power for 1½ hours. What is the total power used to cook the meat? [1]

Total power = ... kW

(iii) Write down in words an equation as it appears on page 2 and use it to calculate the number of units (kWh) used to cook the meat.

Equation: .....

.....

[1]

Calculation [1]

Number of units = ... kWh

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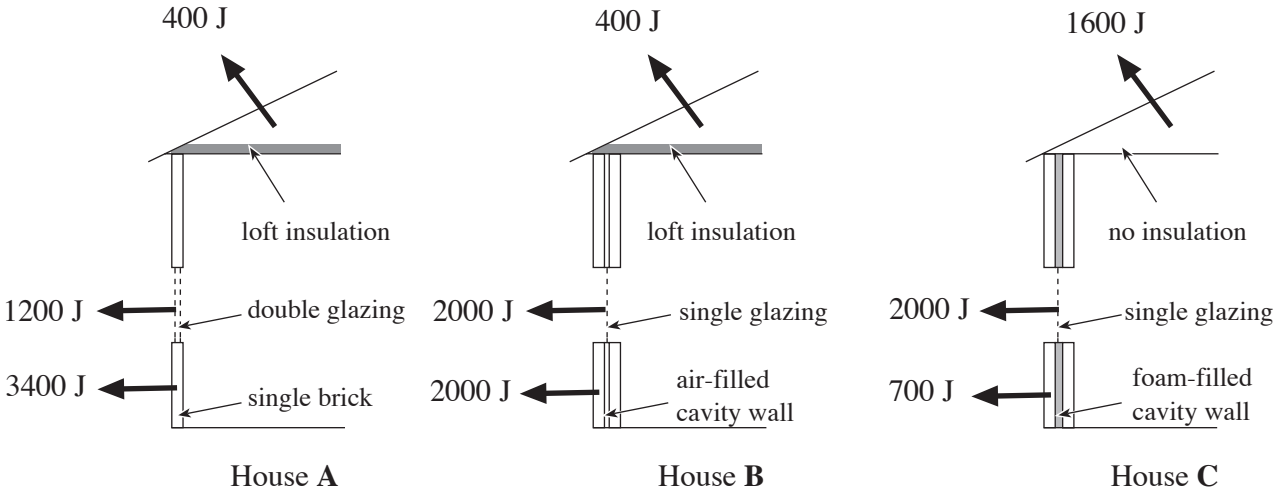
3. The diagrams show 3 houses of identical size. None of the houses is fully insulated.
The diagrams also show how much heat is lost per second from the windows, walls and roof of each house when a temperature difference of 20°C is kept between the inside and the outside.



(a) Use the information in the diagram to find which house loses the least heat energy per second. [1]

Answer: .....

(b) If the owner of house **B** installed double glazing **and** filled the cavity wall with foam, calculate how much energy she would save per second. Show your working. [2]

Total energy saved per second = ... J

(c) (i) Name the process by which heat is lost through the brick walls of a house. [1]

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(ii) Explain why foam-filled cavity walls are better than air-filled cavity walls in reducing heat loss. [2]

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(d) (i) Explain why house **A** requires the most heat energy per second from its heating system to keep a 20°C temperature difference between inside and outside. [1]

.....

.....

(ii) Give **two** advantages to the environment of adjusting the heating system so that the temperature difference between the inside and outside is reduced from 20°C to 18°C. [2]

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.....

9

4. *(a)* The table shows how energy is used in a coal-burning power station.

Energy input per second	Energy output per second	
6000 MJ	3350 MJ	of energy taken away as heat in the water used for cooling
	2100 MJ	of energy fed into the National Grid
	550 MJ	of energy given out in the gases released during burning

Write down in words an equation as it appears on page 2 and use it to calculate the efficiency of the power station.

Equation: .....

.....

[1]

Calculation: [2]

Efficiency = ... %

(b) Large coal-fired power stations are generally built close to lakes or rivers and near to both motorways and mainline railways.

Suggest a reason why coal power stations

(i) require good road and railway links;

.....

.....

(ii) are built near a source of water.

.....

.....

[2]

Examiner only

(c) A combined heat and power station (CHP) makes use of the hot water used for cooling purposes in the power station. This water is piped to provide central heating for the station and homes nearby. The station is 80% efficient.

(i) The energy input from burning coal is 5000 MJ/s.
Calculate the useful output energy. [2]

Useful output = ... MJ/s

(ii) 30% of this useful output energy is fed into the National Grid. Calculate how many MJ/s are used for district heating. [2]

District heating = ... MJ/s

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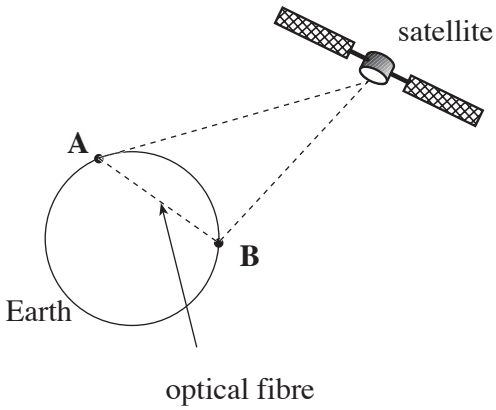
5. To communicate between **A** and **B**, two options are available.

They are:

1 using an infra red signal via a transcontinental optical fibre link;
2 using a microwave signal via a satellite in a geosynchronous orbit.



(a) Explain what the term *geosynchronous orbit* means. [2]

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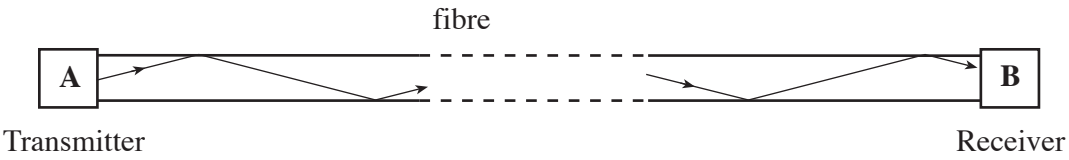
(b) The diagram shows the path of the signal through a transcontinental optical fibre.



(i) Explain clearly why the signal stays inside the optical fibre during its transmission from **A** to **B**. [2]

.....

.....

.....

(ii) The length of the optical fibre is $4{\cdot}8 \times 10^6$ m and the speed of the signal through the fibre is 2×10^8 m/s.
Write down, in words, an equation as it appears on page 2 and use it to calculate the time it takes the signal to travel from **A** to **B**.

Equation: .....

.....

[1]

Calculation: [2]

Time taken = ... s

(iii) Explain why this time delay is very much less than when using a satellite in geosynchronous orbit, even though the microwave signal travels more quickly through space than the infra red signal through the optical fibre. [1]

.....

.....

.....

8

6. *(a)* Young stars form when large clouds of gas (mainly hydrogen) collapse under their own gravity. As they do so, the temperature rises and hydrogen atoms undergo fusion.

Explain what effects the fusion of hydrogen brings about in a developing star. [3]

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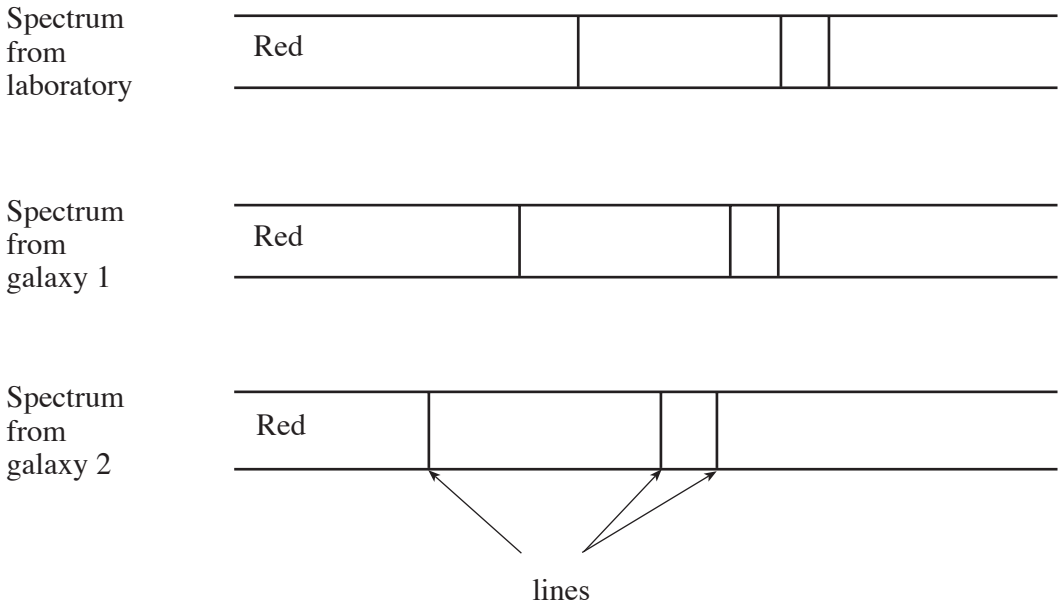
(b) An astronomer observed the spectrum of light from two newly discovered galaxies.
It was seen that the lines in the spectra from both galaxies were 'red shifted' when compared with the spectrum of laboratory light.

The diagram shows the same part of the spectrum from the three sources described above.



(i) What does the 'red shift' tell us about galaxy 1?

.....

(ii) Galaxy 2 produces a greater red shift than galaxy 1.
State **two** things that this suggests to the astronomer about galaxy 2.

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.....

[3]

Examiner only

7. A householder buys gas for **heating and cooking** and electricity for **lighting and operating electrical appliances**.
The table shows information about the householder's energy consumption and the total yearly cost.

Year	Units of electricity (kWh)	Units of gas (kWh)	Total units of energy (kWh)	Total cost
1st Jan - 31st Dec 2005	4309	36958	41267	£866.62
1st Jan - 31st Dec 2006	4540	33446	37986	£949.65

(a) Write down, in words, an equation as it appears on page 2 and use it together with data from the table to find the overall cost of 1 unit (kWh) of energy in 2006.

Equation: .....

.....

[1]

Calculation: [2]

Cost per unit = £ ..... per kWh

(b) On **1st January 2006** the householder fitted a solar panel, at a cost of £2000, to provide **hot water for heating**.

(i) Use data from the table to estimate the number of units produced by the Solar Panel in 2006.

Number of units = ...

(ii) **Use the answer in part (a)** to calculate the amount of money saved on his **2006 gas bill**.

Money saved = £ .....

(iii) Calculate the time it would take for his annual savings to pay back the cost of the Solar Panel.

Payback time = ... years

(iv) Give a reason why the payback time calculated in (iii) could be much smaller.

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[6]

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