Candidate Name	Centre Number	Candidate Number

WELSH JOINT EDUCATION COMMITTEE

General Certificate of Secondary Education

CYD-BWYLLGOR ADDYSG CYMRU

Tystysgrif Gyffredinol Addysg Uwchradd

237/02

SCIENCE

HIGHER TIER (Grades D-A*)

PHYSICS 1

A. M. FRIDAY, 26 January 2007

(45 minutes)

For Examiner's use only	
Total Marks	

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.

No certificate will be awarded to a candidate detected in any unfair practice during the examination.

EQUATIONS

power = voltage × current

energy transfer = power × time

units used = 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

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

Answer **all** *questions.*

1. A gas customer had double glazing installed on 1st February.
The table shows the gas meter readings 3 months before installation and 3 months after.

Date	1st November	1st February	1st May
Readings (units)	6500	7610	8525

(a) Calculate:

(i) the number of units used in the 3 months before the double glazing was installed;

Number of units = ...

(ii) the number of units used in the 3 months after the double glazing was installed.

Number of units = ...
[2]

(b) If each gas unit cost 43 p, calculate how much money was saved on the gas bill after installing double glazing. [2]

Money saved = ...

(c) The gas customer claimed that the money saved was entirely due to the installation of the double glazing.
Explain why this claim is not scientifically correct. [2]

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6

Turn over.

2. *Read the passage carefully before answering the questions that follow.*

Over the last 5 years there has been a massive increase in the use of mobile phones by children under 10 years old.
A number of studies have suggested a possible health risk for frequent users of mobiles. They are more likely to experience cell damage leading to changes in brain function and, in extreme cases, to cancer.
The health risk is linked to the microwaves given out by the mobiles. These microwaves are absorbed by the water molecules in brain cells. This generates heat which may cause damage to the cells.
Although there is no direct evidence, some scientists believe that the risk is greater for younger rather than older people. The Government has advised that children under 8 should use mobile phones in emergencies only.

(a) Explain

(i) why brain cells absorb microwaves;

.....

(ii) how microwaves may damage cells of the body.

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[2]

(b) According to the passage, how may the health of frequent mobile phone users be affected? [2]

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(c) Suggest a reason why children under 8 years old should not use mobile phones very often. [1]

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(d) What needs to be done in the future to find out if the results mentioned in the passage are reliable and valid? [1]

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3. The Solar System consists of the Sun and its planets.

(a) The table gives data on four planets in the Solar System.

Planet	Distance from the Sun (million km)	Time for one orbit (years)	Average surface temperature
Earth	150	1·0	15 °C
Mars	228	1·9	–23 °C
Jupiter	778	11·9	–120°C
Saturn	1427	29·5	–180 °C

The **asteroid belt** lies between Mars and Jupiter. Asteroids are bits of rock, of varying size, which never collected to form a planet.
If the planet **had** formed from the bits of rock, use the data in the table to estimate its:

(i) distance from the Sun; .....

(ii) orbit time; .....

(iii) surface temperature. ..... [3]

(b) Astronomers believe that, after the Sun formed 4·5 billion years ago, the remaining gas, dust and ice collected together to form the planets.
The 4 inner planets have a different make up (structure) from the 4 outer planets (excluding Pluto).

(i) State how the inner planets are structurally different from the outer planets.

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(ii) Explain how the structural difference between the planets was influenced by the energy from the newly-formed Sun.

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[3]

(c) The time will come when our Sun will become a white dwarf star. Explain what changes will happen inside the Sun to cause it to become a white dwarf. [3]

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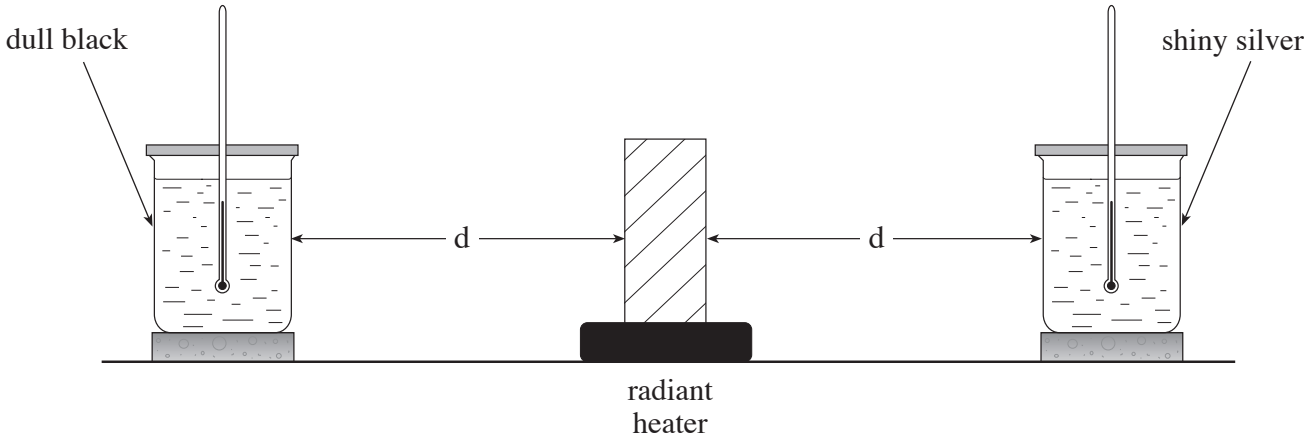
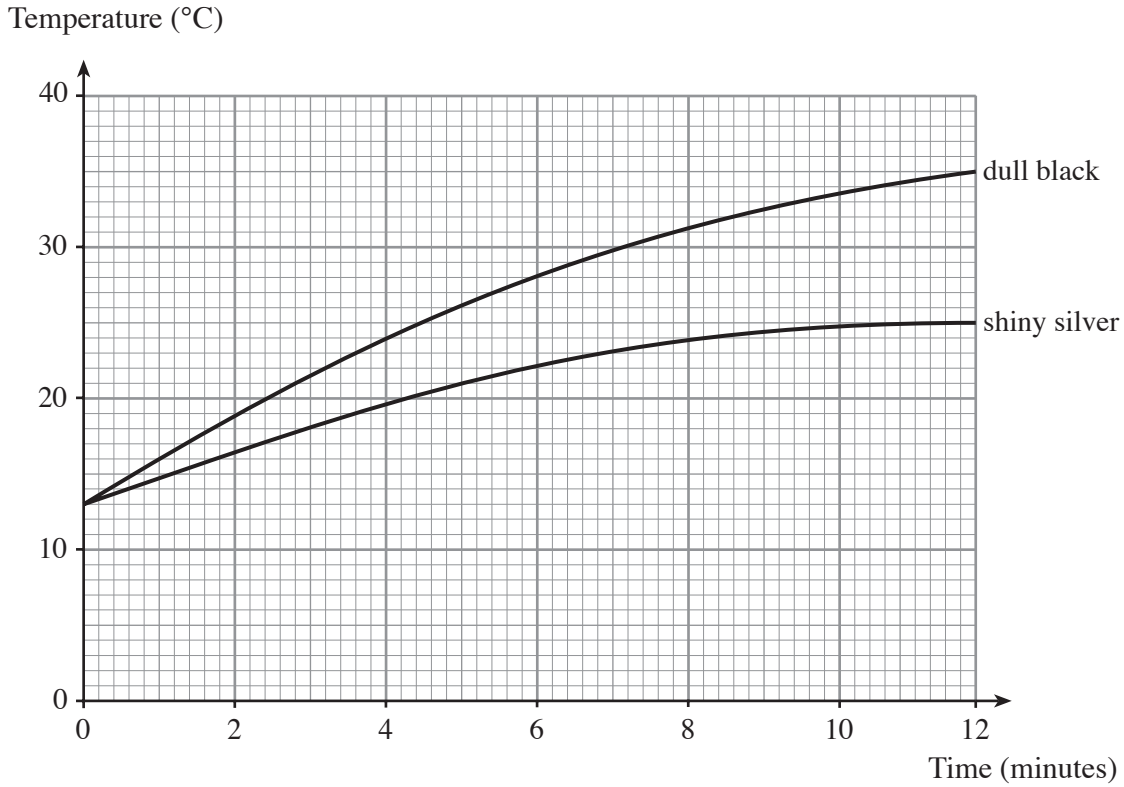
4. Two similar cans are partly filled with equal amounts of paraffin.
Each can holds a thermometer, is covered by a lid and stands on a cork base, the same distance (d) away from a radiant heater.
One of the cans has a dull black surface and the other has a shiny silver surface.



The graphs show how the temperature of the paraffin changes for the two cans.



(a) Calculate the number of degrees per minute gained by the paraffin in the dull black can over the time of the experiment. [2]

Temperature gain per minute = ... °C / min

(b) The cans receive most of their energy by radiation.

(i) Explain why they receive little heat by conduction through the air between the heater and the cans.

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(ii) Explain why they receive little heat by convection.

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[2]

(c) Suggest a reason for using a lid on the cans and placing them on a cork base. [1]

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(d) What scientific conclusion can you make about the results of the experiment? [1]

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5. A 20 W low energy lamp produces the same amount of light as a 100 W filament lamp. The table below gives information about both lamps.

	20 W energy-saving lamp	100W filament lamp
Power	20 W	100 W
Operating voltage	240 V	240 V
Operating current	$\frac{1}{12}$ A	$\frac{5}{12}$ A
Operating life	15 000 h	1000 h
Cost to buy	£2.69	£0.45
Light energy produced	5 J/s	5 J/s

(a) How much energy is wasted per second by the filament lamp? ..... [1]

(b) (i) Electricity is charged at the rate of 8 p per unit. **Select equations** and **then** use them to show clearly that the cost of using the 20 W lamp for 5 hours per day for 1 week is 5·6 p. [3]

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(ii) Use the information in the table to explain why it costs 28 p to use the filament lamp for the same period of time. [1]

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(c) The 20 W lamp costs more to buy but less money to use than the filament lamp. Calculate how many weeks it would take for the savings per week to pay the extra cost of buying the 20 W lamp. [3]

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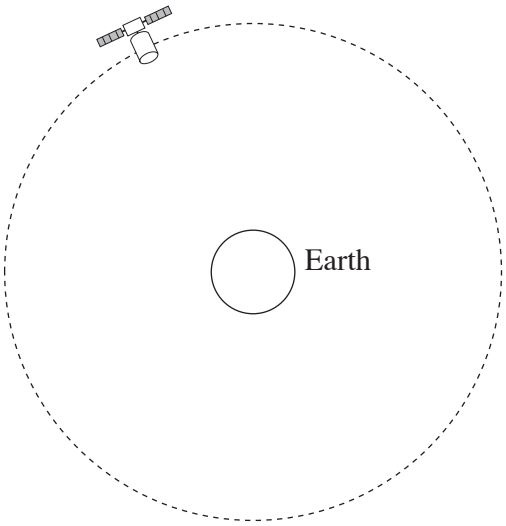
6. The diagram shows a communications satellite in a geostationary orbit around the Earth.



(a) Explain why communications satellites are put into geostationary orbits. [1]

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(b) A microwave signal, of frequency 5×10^9 Hz and speed 3×10^8 m/s, carries TV pictures from a studio to a geostationary satellite $3{\cdot}6 \times 10^7$ m above the equator. The satellite receives the signal and then transmits it back to Earth, where it is received by homes with 'satellite dishes.'

(i) **Select an equation** and **then** use it to calculate the wavelength of the microwave signal. [3]

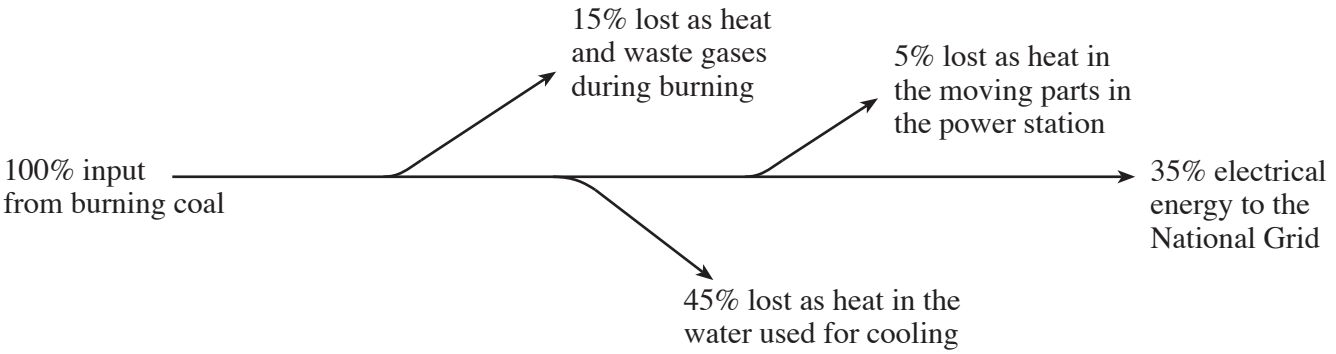
Wavelength = ... m

(ii) **Select an equation** and **then** use it to calculate the time for the TV pictures to travel from the studio to the homes of viewers. [3]

Time = ... s

7

7. The energy flow diagram for a coal-fired power station is shown below.



This power station is 35% efficient in generating electricity. It releases 65% of the energy from burning coal into the environment,

(a) State what effects coal-fired power stations have on the environment. [3]

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(b) **Combined heat and power (CHP) stations** are replacing some conventional ones. These make use of the heat in the water that is used for cooling purposes. The water is piped to provide central heating for the power station and houses nearby.
A particular CHP station receives 400 MJ/s of energy from burning coal.
210 MJ/s is distributed for district heating. The power station is 82% efficient.

(i) **Select an equation** and **then** use it to calculate the useful energy transferred by the power station each second.

Useful energy transferred per second = ...MJ/s

(ii) Calculate the number of MJ/s of electrical energy transferred to the National Grid by the power station.

Energy transferred to Grid per second = ...MJ/s

(iii) Suggest a reason why CHP stations should be located near a large community.

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[5]

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