WJEC GCSE PHYSICS

PHYSICS



EXAM QUESTION PACK

UNIT P1 HIGHER TIER 0237 PAPERS

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

0237/02

SCIENCE
HIGHER TIER
PHYSICS 1

A.M. WEDNESDAY, 30 January 2013

45 minutes

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

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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.

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EQUATIONS

power = voltage × current

energy transfer = power × time

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

cost = units used (kWh) × cost per unit

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

wave speed = wavelength × frequency

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

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}

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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)	5 100	6 325	7 335

(a) Calculate:

(i) the number of units used in the 3 months **before** the double glazing was installed: [1]

Number of units = ...

(ii) the number of units used in the 3 months **after** the double glazing was installed. [1]

Number of units = ...

(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 = ... p

(c) The gas customer claimed that the money saved was entirely due to the installation of the double glazing.
Give a reason why this claim is not scientifically correct. [1]

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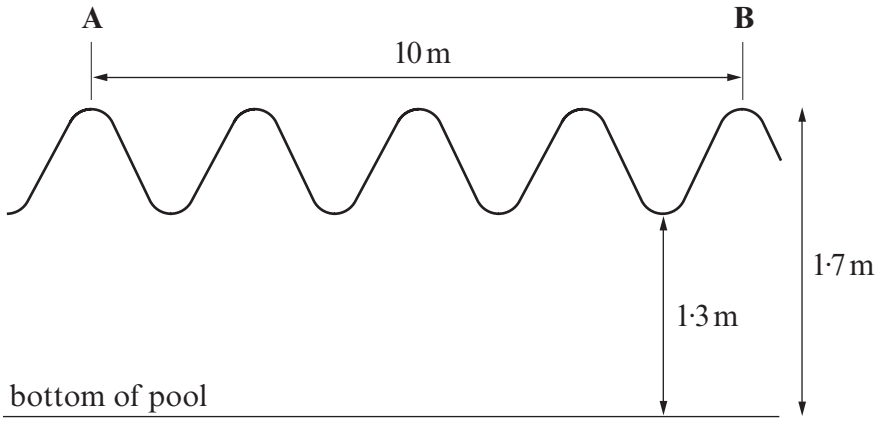
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Turn over.

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2. The diagram shows a side view of the water waves, produced in a swimming pool by a wave machine.



(a) Use information given on the diagram to find:

(i) the amplitude of the waves; [2]

Amplitude = ... m

(ii) the number of complete waves between **A** and **B**; ..... [1]

(iii) the wavelength of the water waves. [1]

Wavelength = ... m

(b) State what happens to the wavelength of the water wave when the frequency of the wave machine is increased. [1]

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

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	1 427	29·5	–180 °C

Ceres is a large asteroid which orbits the Sun in the asteroid belt.

(a) What is the asteroid belt? [1]

.....

.....

(b) Use the data in the table to make a reasonable estimate of: [2]

(i) the distance of Ceres from the Sun; ..... million km

(ii) the temperature on the surface of Ceres. ..... °C

(c) 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. [1]

.....

.....

(ii) Explain how the structural difference between the planets was influenced by the energy from the newly-formed Sun. [1]

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4. The table below gives information about three household appliances.

Appliance	Power (W)	Power (kW)	Time used per day	Units used per day (kWh)
Washing machine	1 200	1·2	2 hours	2·4
Kettle	.....	.....	1½ hours	3
Food mixer	720	0·72	5 minutes	.....

Use the information given about the kettle and food mixer to complete the table. [5]

Space for working.

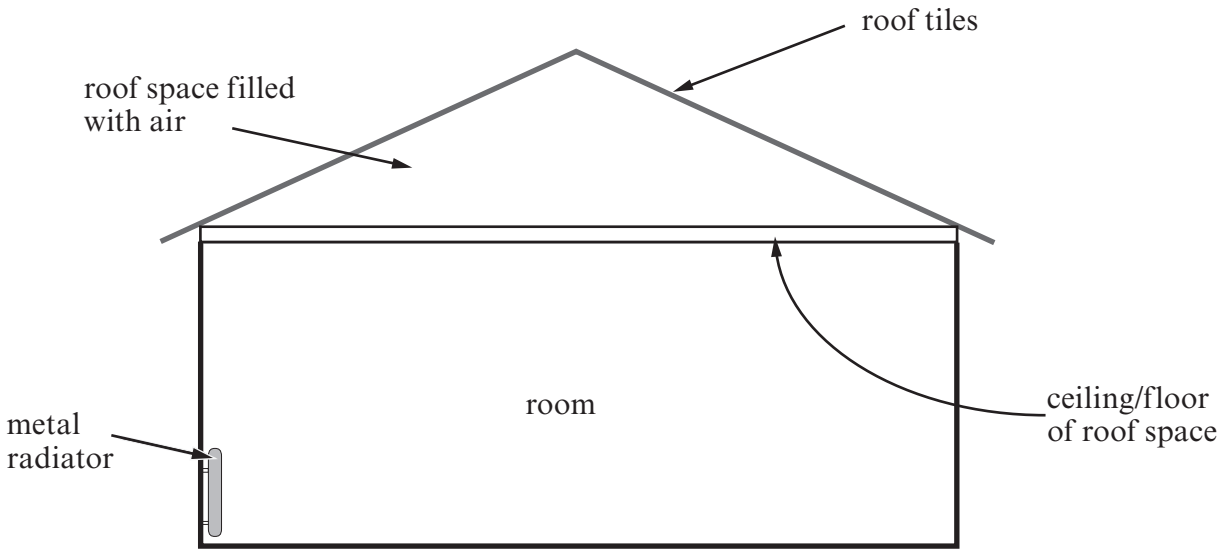
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5.



The room of the above house is heated by a metal radiator which receives hot water from the boiler of the central heating system of the house.

(a) (i) Describe the processes involved by which the room becomes heated from the hot water circulating in the radiator. [3]

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(ii) Give a reason why painting the radiator a dark colour would improve heat transfer from the radiator to the room. [1]

.....

.....

(b) (i) State the processes by which heat is lost from the room through the ceiling and then the roof space. [2]

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(ii) Explain how covering the floor of the roof space with fibre glass would reduce heat loss from the room. [2]

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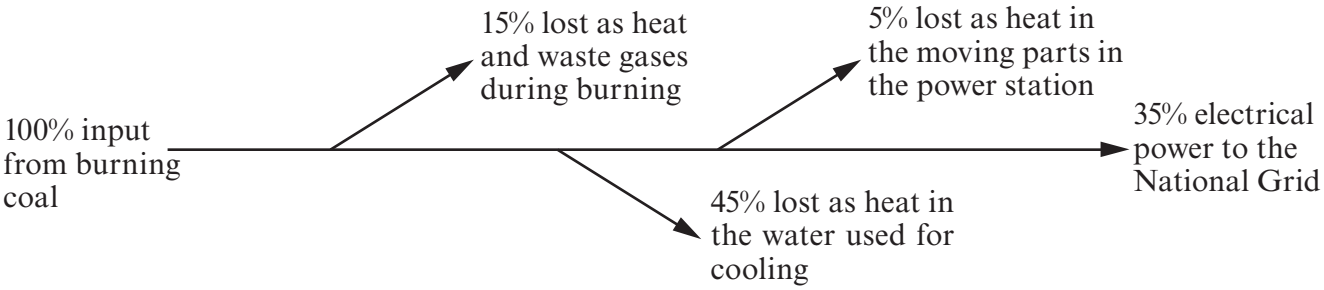
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6. *(a)* Use the information below to explain what effects coal-fired power stations have on the environment. [3]



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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 MW of power from burning coal. It is 82% efficient. Of the useful power output 118 MW is transferred to the National Grid.

(i) Select an equation from page 2 and use it to calculate the total amount of useful power transferred by the CHP station.

Equation: ..... [1]

Total useful power = ... MW [2]

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(ii) Calculate the amount of power available for district heating. [1]

Power for district heating = ... MW

(iii) Suggest a reason why CHP stations should be located near to large communities. [1]

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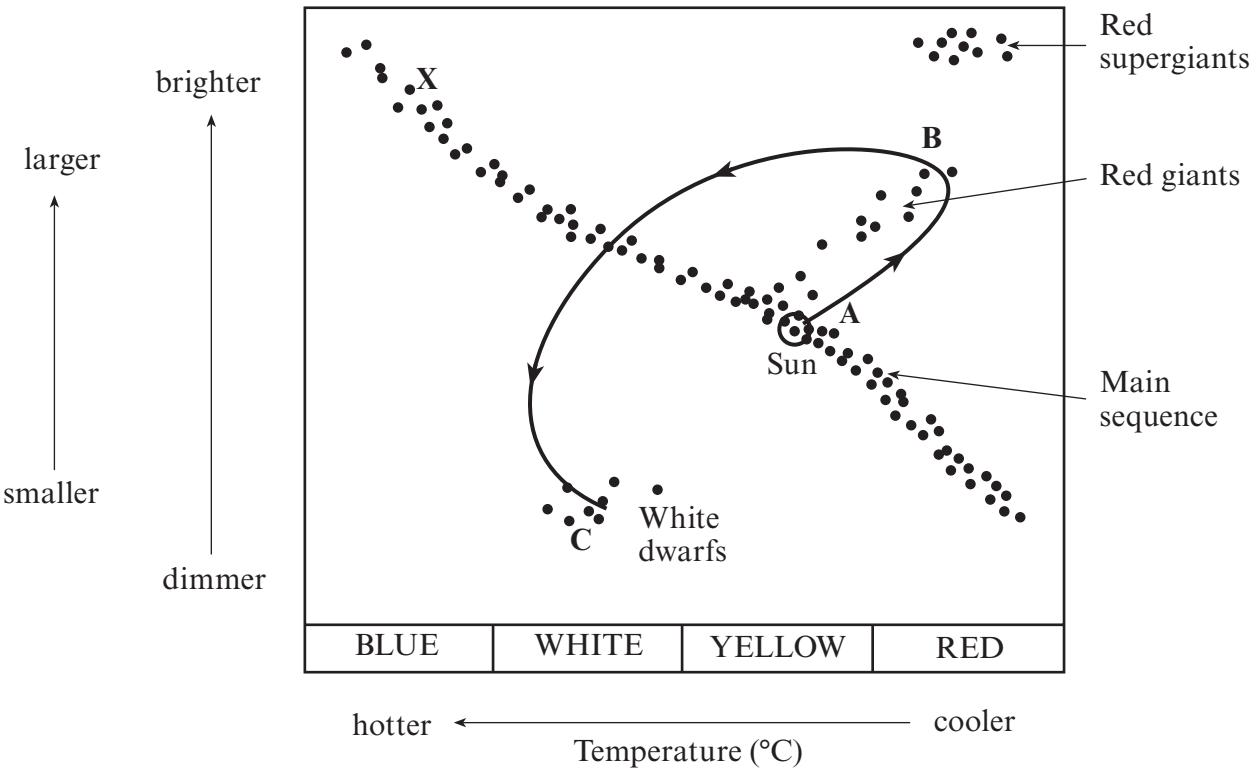
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7. The diagram shows how the size, brightness and colour of a star are related to its temperature,



Our Sun is currently a main sequence star. Main sequence stars produce energy by the fusion of hydrogen into helium. In a stable star, the fusion process produces an outward pressure (a combination of gas pressure and radiation pressure) which exactly balances the gravitational force.

The bold line **ABC** shows the changes the Sun will undergo when it comes to the end of its life.

(a) When all the hydrogen runs out our Sun will fuse helium.

(i) State how this will affect the forces acting on the Sun. [1]

.....

.....

(ii) Use the diagram to explain how the appearance of the Sun will change. [2]

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(b) (i) Star X is larger than our Sun. Suggest a reason why it is hotter and brighter than our Sun. [1]

.....

.....

(ii) Explain what is likely to happen to star X when all its hydrogen runs out. [3]

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7

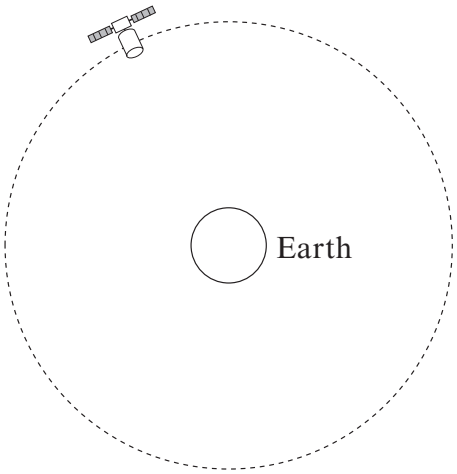
TURN OVER FOR QUESTION 8

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



(a) Explain why a satellite in a geostationary orbit appears to be in a fixed position even though it is moving in orbit. [2]

.....

.....

.....

(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'.

Use the equations: $\text{wavelength} = \dfrac{\text{wave speed}}{\text{frequency}}$ and $\text{time} = \dfrac{\text{distance}}{\text{speed}}$

(i) to calculate the wavelength of the microwave signal

wavelength = ... m

(ii) to calculate how long it takes for the TV pictures to travel from the studio to the homes of the viewers.

time = ... s

[5]

END OF PAPER

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GCSE MARKING SCHEME

SCIENCE - PHYSICS (LEGACY)

JANUARY 2013

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2013 examination in GCSE SCIENCE - PHYSICS (LEGACY). They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

Unit	Page
P1 - FOUNDATION TIER	1
P1 - HIGHER TIER	4
P2 - FOUNDATION TIER	7
P2 - HIGHER TIER	10
P3 - FOUNDATION TIER	13
P3 - HIGHER TIER	16

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GCSE Science - Physics (Legacy) - P1

Mark Scheme

FOUNDATION TIER

Question			Marking details	Marks Available
1.			230[V 50 Hz], 2450[MHz], 0.8 kW/800 W, 800 **Question total**	4 **[4]**
2.	*(a)* *(b)*		250 (1) 100 (1) 2400/150 = 16 years substitution (1), answer (1) **Question total**	2 2 **[4]**
3.			D A B E 3 or 4 correct = 3 marks 2 correct = 2 marks 1 correct = 1 mark **Question total**	3 **[3]**
4.		(i) (ii)	100/4 = 25 [p] 4/1.6 = 2.5 [h] substitution (1) answer (1) **Question total**	1 2 **[3]**
5.	*(a)* *(b)*	(i) (ii) 	X rays / microwaves UV / X rays / gamma smaller / lower change in energy [of the charged particle] **Question total**	1 1 1 **[3]**

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Question			Marking details	Marks Available
6.	*(a)*	(i)	radiation	1
		(ii)	convection	1
	(b)		$\frac{2.5}{5}$ = 50 [%] substitution (1) answer (1)	2
			Question total	**[4]**
7.	*(a)*		No fuel costs / limited pollution / generated immediately Don't accept renewable	1
	(b)	(i)	An environmental decision	1
		(ii)	Step-up / change voltage (1) so that energy loss in the cables is minimised. (1)	2
			Question total	**[4]**
8.	*(a)*	(i)	Box 2	1
		(ii)	Box 3	1
		(iii)	Box 1	1
	(b)		Any 2 x (1): More signals per cable / less interference / faster /more secure	2
			Question total	**[5]**
9.	*(a)*		Any 2 x (1): Lagging roof space / double glazing / draught excluding on doors etc	2
	(b)	(i)	Bad conductor / traps heat (1) because of air gaps (1)	2
		(ii)	Prevents movement of air pockets in the cavity	1
			Question total	**[5]**

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Question			Marking details	Marks Available
10.	*(a)*	(i)	6325-5100 = 1225 (1)	
		(ii)	7335-6325 = 1010 (1)	2
	(b)		Units saved = 1225-1010 = 215 units (1) **ecf**	
			Money saved = 215 **ecf** x 43 = 9245 [p] / [£]92.45 (1)	2
			Both answers to (*a*) x 43 award 1 mark only	
	(c)		No account taken of different conditions re: weather and gas charges	1
			Question total	**[5]**
11.	*(a)*	(i)	$\frac{(1.7-1.3)(1)}{2} = \frac{0.4}{2} = 0.2$[m] (1)	2
		(ii)	4	1
		(iii)	10/4 = 2.5 [m]	1
	(b)		Reduced [when speed is constant]	1
			Question total	**[5]**
12.	*(a)*		A group of rocks of various sizes orbiting the Sun / between Mars and Jupiter	1
	(b)	(i)	Between 350-650 [million km]	2
		(ii)	-50 and -100 [^{o}C]	
	(c)	(i)	Inner rocky / outer gaseous	1
		(ii)	Sun's radiant energy easily pushed the gases to the outer reaches	1
			Question total	**[6]**
			Total Foundation paper	**50**

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HIGHER TIER

Question			Marking details	Marks Available
1.	*(a)*	(i)	6325-5100 = 1225 (1)	
		(ii)	7335-6325 = 1010 (1)	2
	(b)		Units saved = 1225-1010 = 215 units (1) **ecf**	
			Money saved = 215 **ecf** x 43 = 9245 [p] / [£]92.45 (1)	2
			Both answers to (*a*) x 43 award 1 mark only	
	(c)		No account taken of different conditions re: weather and gas charges	1
			Question total	**[5]**
2.	*(a)*	(i)	$\frac{(1.7-1.3)(1)}{2} = \frac{0.4}{2} = 0.2$[m] (1)	2
		(ii)	4	1
		(iii)	10/4 = 2.5 [m]	1
	(b)		Reduced [when speed is constant]	1
			Question total	**[5]**
3.	*(a)*		A group of rocks of various sizes orbiting the Sun / between Mars and Jupiter	1
	(b)	(i)	Between 350-650 [million km]	2
		(ii)	-50 and -100 [^{o}C]	
	(c)	(i)	Inner rocky / outer gaseous	1
		(ii)	Sun's radiant energy easily pushed the gases to the outer reaches	1
			Question total	**[5]**

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Question			Marking details	Marks Available
4.			Kettle: 2000 (1) 2(1) **ecf** on power (W) conversion Food mixer: $\frac{5}{60}$ x 0.72 = 0.06 (1) correct power (1), conversion (1) Answer of 3.6 with no working shown award 1 mark Answer of 3.6 with working shown award 2 marks **Question total**	5 **[5]**
5.	*(a)*	(i)	Award (1) x 3: By conduction through the metal (1), radiates heat to people directly in front of the radiation (1), air in contact becomes heated and rises – circulating the room / forming convection currents to heat the room (1) mechanism of convection (1).	3
		(ii)	Dark colours are best **<u>radiators / emitters</u>** of heat	1
	(b)	(i)	Conduction [through ceiling] (1) and mainly convection [through the roof space] (1)	2
		(ii)	Air gaps in fibre glass reduces conduction through the ceiling (1) and [as a consequence] reduces convection since little heat conducted (1)	2
			Question total	**[8]**

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Question			Marking details	Marks Available
6.	*(a)*		Any 3 x (1): Localised heating effects e.g. rivers Inefficient (can be implied) Carbon dioxide / CO_2 leads to global warming Sulphur dioxide / SO_2 leads to acid rain	3
	(b)	(i)	% efficiency = <u>useful power transfer</u> x 100 total power input	1
			$\frac{82x400}{100} = 328$ [MW] substitution (1) answer (1)	2
		(ii)	328-118=210 [MW]	1
		(iii)	To minimise heat losses / ease of access to the energy / benefit to more people	1
			Question total	**[8]**
7.	*(a)*	(i)	Forces unbalanced, radiation pressure greater than gravity	1
		(ii)	Correct sequence red giant to white dwarf (1) Any 2 points from the graph relevant to the red giant or white dwarf (1) (don't accept reference to colour)	2
	(b)	(i)	More energy produced by fusion / more hydrogen to fuse	1
		(ii)	Any 3 x (1): Expand to a red supergiant (1) and cools (1) and eventually becomes a supernova (1) leaving behind a black hole / neutron star (1)	3
			Question total	**[7]**
8.	*(a)*		Satellite takes the same <u>time</u> to orbit / 24 hours (1) as it takes for the Earth to spin once on its axis (1)	2
	(b)	(i)	$\frac{3x10^8}{5x10^9} = 0.06$ [m] substitution (1) answer (1)	
		(ii)	$\frac{2(1)x3.6x10^7}{3x10^8} = 0.24$ [s] substitution (1) answer (1)	5
			Question total	**[7]**
			Total Higher Tier	**50**

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

0237/02

SCIENCE
HIGHER TIER
PHYSICS 1

P.M. FRIDAY, 15 June 2012

45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**5**	
3.	**8**	
4.	**8**	
5.	**7**	
6.	**8**	
7.	**9**	
Total	**50**	

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020001

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EQUATIONS

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

wave speed = wavelength × frequency

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

Commonly used prefixes			
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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}

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Answer **all** *questions.*

1. Microwaves are a type of electromagnetic radiation. They are reflected from metals but can pass through glass, pottery and some plastics.

Most food cooked in a microwave oven has a high water content, which readily absorbs the microwave energy producing a rapid rise in temperature. This results in the food being cooked quickly.

(a) (i) Explain why the choice of container for the food is important in microwave cookery. [2]

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(ii) Give a reason why microwave ovens cook food quicker than a conventional oven. [1]

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(b) X-rays and gamma rays are other types of electromagnetic radiation. State **two** ways in which they differ from microwave radiation. [2]

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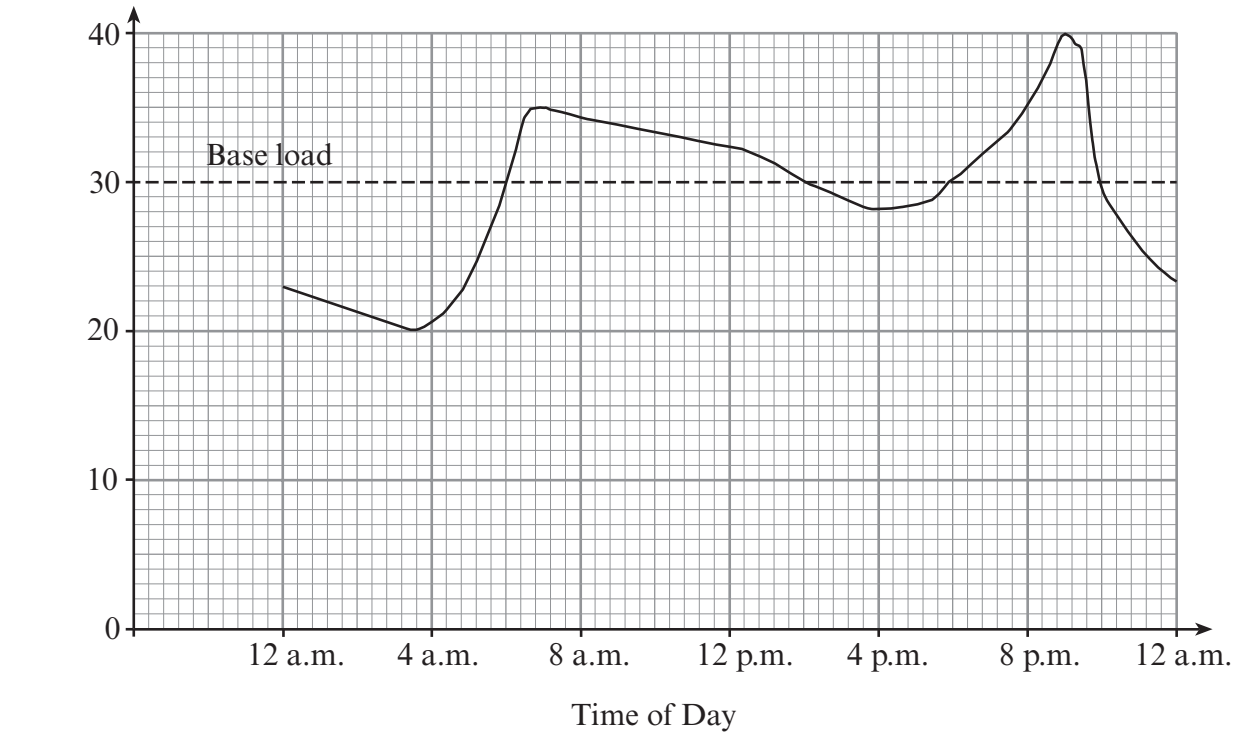
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2. The graph shows how the demand for electricity changes over a 24 hour period, in this country, during winter.



Since electrical power cannot be stored in large quantities most fossil fuelled and nuclear power stations are run continuously, to provide a minimum amount of power to the National Grid. This is called the base load. Most hydroelectric power stations only operate at times of peak demand for power because they have a much shorter start-up time than other power stations.

(a) (i) Between 4 a.m. and 4 p.m. how many hours is the demand above the "base load"? [1]

Number of hours = ...

(ii) How much reserve generating capacity must the electrical industry have available, to meet the peak demand for the 24 hour period shown by the graph? [1]

Reserve capacity = ... GW

(b) Give a reason why electrical power is offered at low cost between 12 a.m. and 5 a.m. [1]

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(c) Why does a hydroelectric power station have a much shorter start-up time than fossil fuelled power stations? [1]

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(d) Suggest how the electrical industry deals with the reduced demand for power during the summer months. [1]

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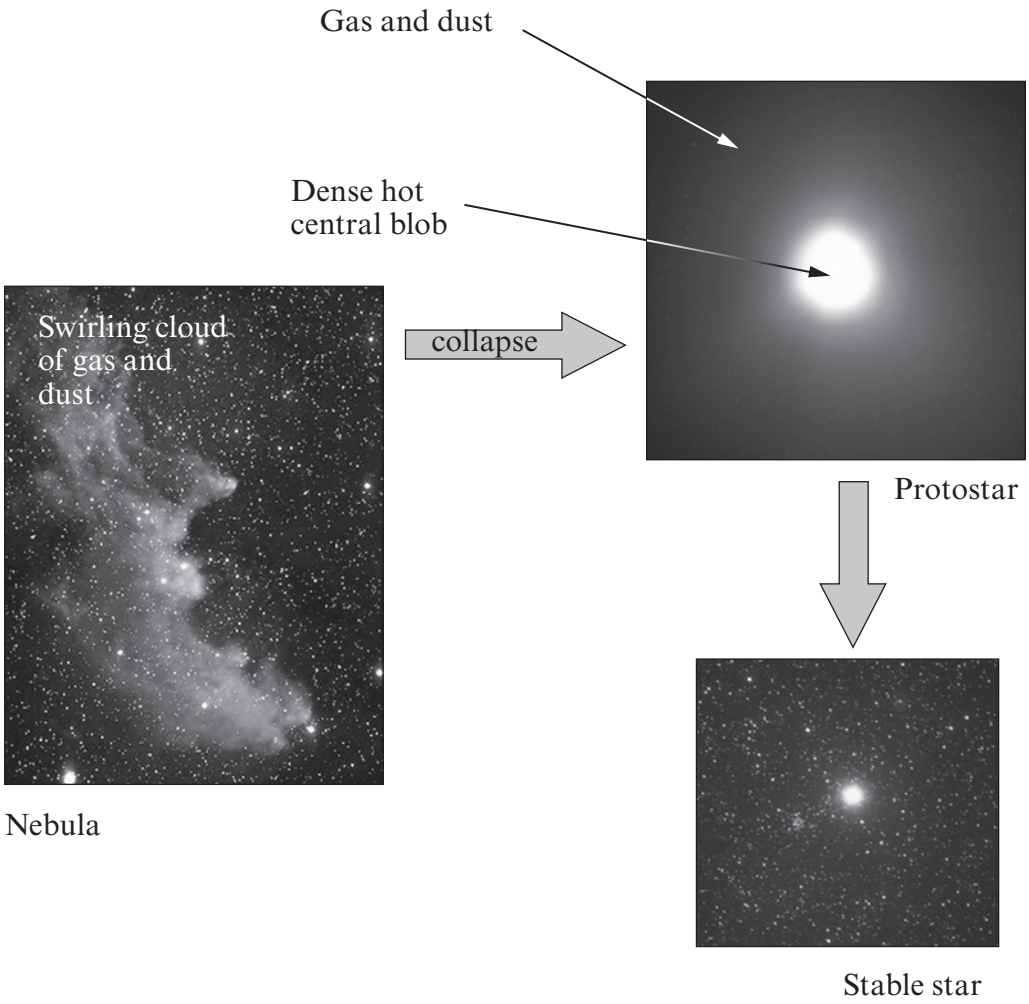
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3. The diagram shows the stages in the birth of a star which takes place over many millions of years.



(a) What causes the gas and dust in the nebula to collapse? [1]

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(b) Explain what happens in the core of the protostar to cause it to glow and produce a large outward radiation pressure force. [2]

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(c) Explain what causes the protostar to eventually become a stable or main sequence star. [2]

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(d) (i) Give a brief outline of the 19th century model of the source of the Sun's energy. [2]

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(ii) State the evidence that proved that this model needed to be replaced. [1]

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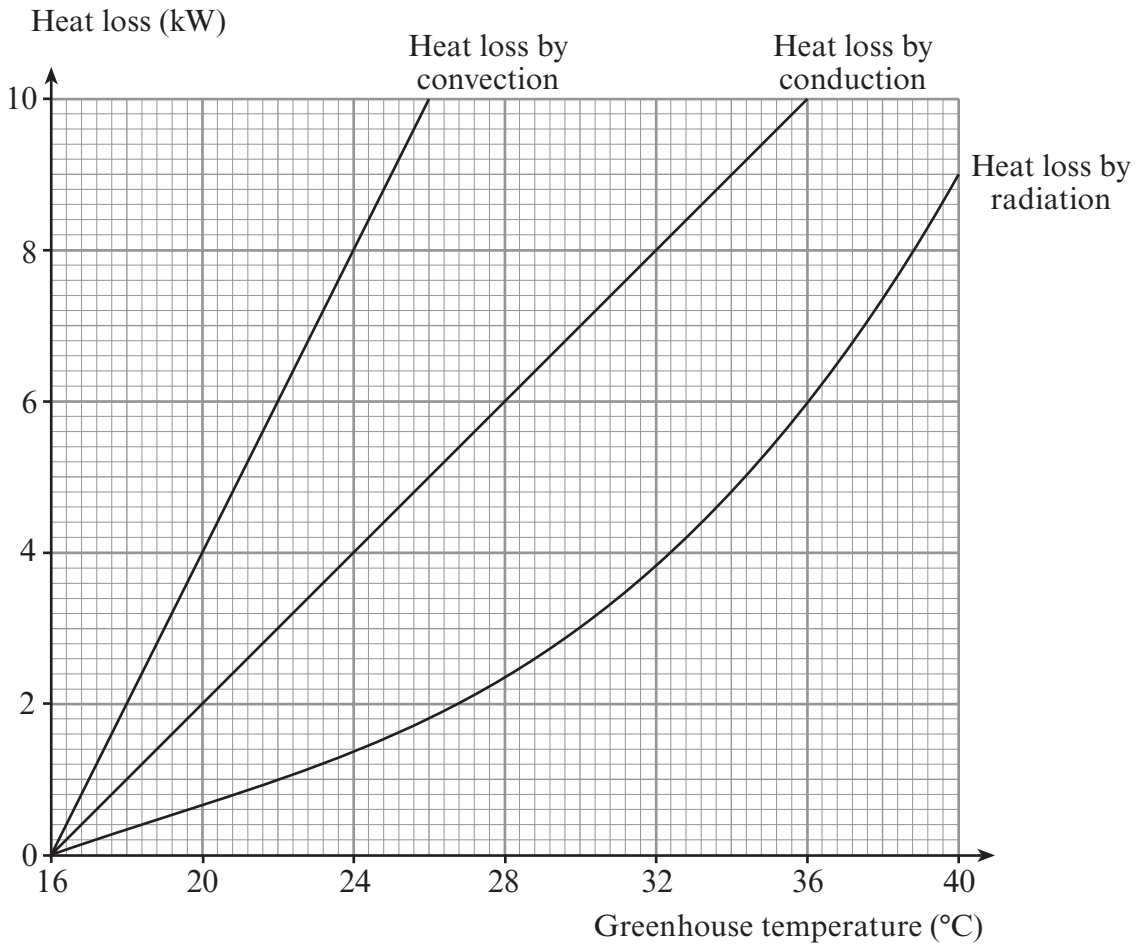
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4. A greenhouse loses heat by conduction and radiation through the glass and by convection when the windows are opened.
The three graphs show how the heat loss from the greenhouse varies with the temperature inside the greenhouse.
One day the outside temperature was 16 °C and the greenhouse was **absorbing 10 kW of power from the Sun**.



(a) The temperature inside the greenhouse reached 30 °C. Use the graphs to find the heat loss by:

(i) conduction; .....

(ii) radiation. ..... [2]

(b) Use your answers to *(a)* to explain why the temperature remained constant at 30 °C when the windows were closed. [1]

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.....

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(c) The greenhouse windows were then opened.

(i) Give a reason why the temperature inside the greenhouse dropped. [2]

.....

.....

(ii) Calculate the total heat loss from the greenhouse when the inside temperature was 24 °C. [2]

Total heat loss at 24 °C = ... W

(iii) Use the three graphs to find the new steady value of the temperature in the greenhouse. [1]

New steady value of temperature = ... °C

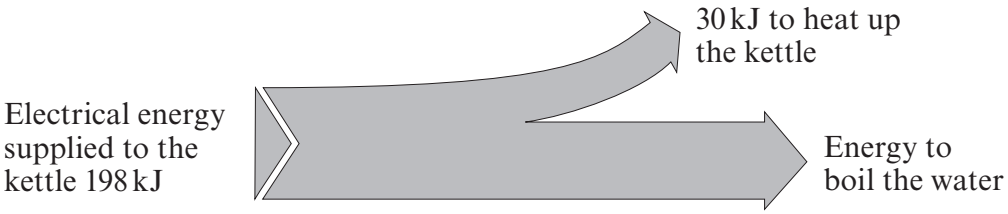
8

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5. The energy flow diagram shows how the energy supplied to a 2200 W kettle is used to boil 0.5 kg of water.



(a) Use the equation

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

to calculate the efficiency of the kettle in boiling the 0.5 kg of water. [3]

Efficiency = ... %

(b) Select an equation from page 2 and use it to find how long it took to boil the water.

Equation:

.....

[1]

Calculation: [3]

Time taken = ... s

7

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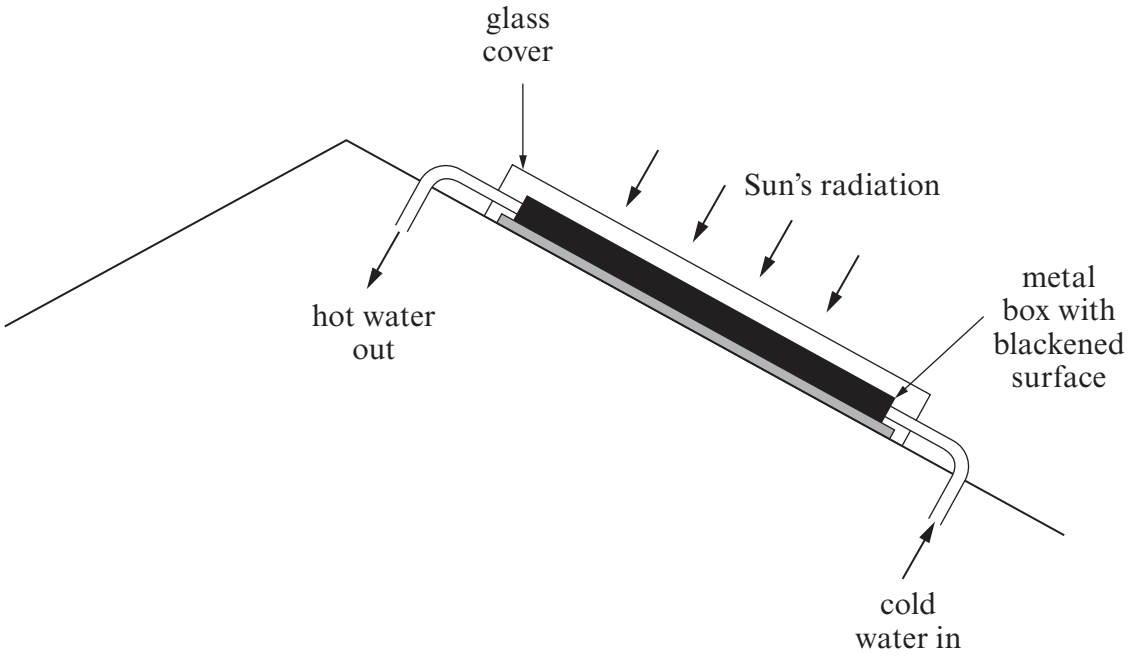
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6. The diagram shows a solar panel that can be roof mounted and used to provide hot water. The water is circulated through the panel's metal box by a pump. The water becomes heated by absorbing some of the Sun's radiation.



(a) Explain why the output temperature of the water is increased by:

(i) putting a glass cover over the metal box; [1]

.....

.....

(ii) blackening the upper surface of the metal box. [1]

.....

.....

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(b) In the U.K. on a typical summer's day the power of sunlight falling on a 4.8 m^2 solar panel varies between 1000 W/m^2 and 400 W/m^2 over a 10 hour period.

(i) If only half the power of the sunlight is delivered to heat the water, calculate the maximum and minimum power produced by the panel. [2]

Maximum power = ... kW Minimum power = ... kW

(ii) Estimate the energy, in kWh, given to the water on this day. State clearly any assumptions you make. [2]

.....

.....

.....

.....

(c) Give **two** reasons why an alternative source of energy may be required to heat the water for the household in winter. [2]

1. .....

.....

2. .....

.....

8

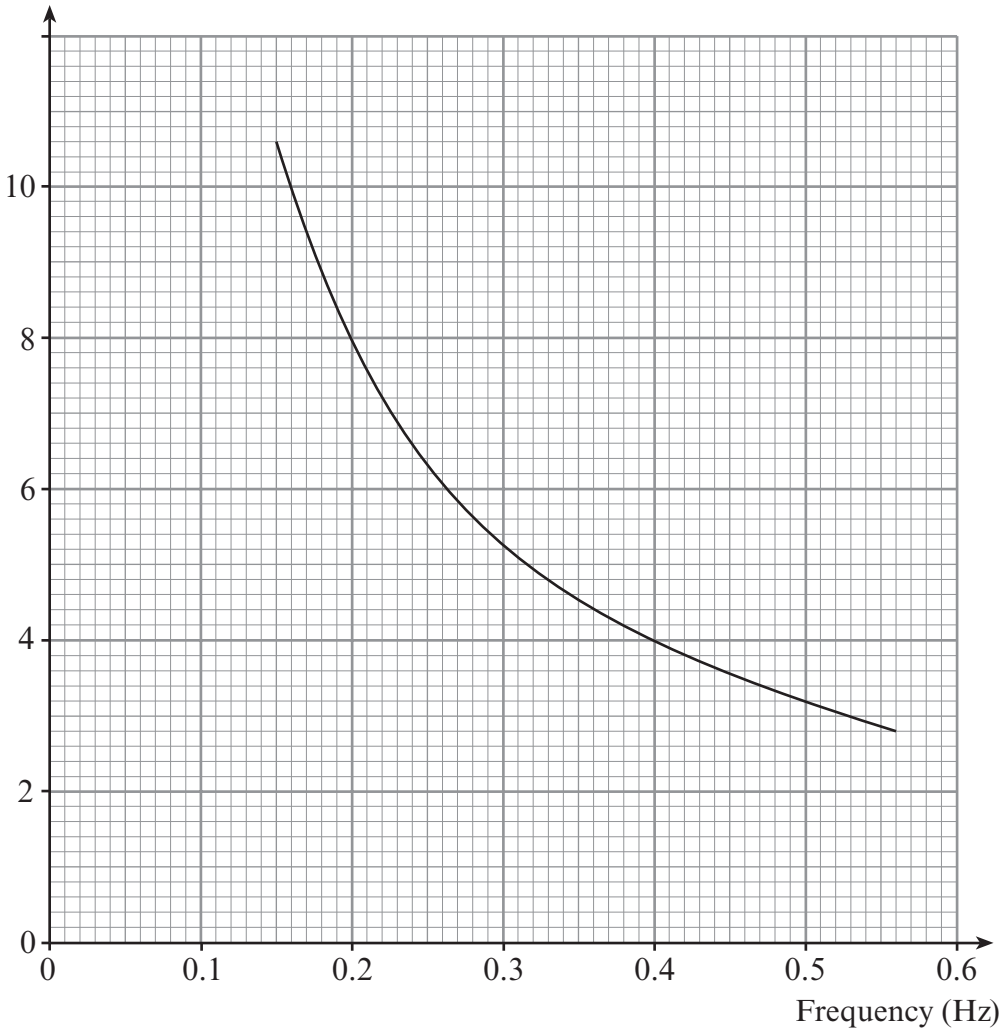
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7. The graph shows how the wave speed of deep ocean waves varies with the frequency of the waves.



(a) Describe the relationship between wave speed and frequency of deep ocean waves. [2]

.....

.....

.....

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(b) A tropical storm produced waves with long wavelengths. The storm occurred at sea, 311 000 m from the mainland.

Use the equations

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

and

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

together with the graph to calculate the wave speed and wavelength of the waves that arrive at the mainland in 12 hours. [7]

Wave speed = ... m/s

Wavelength = ... m

9

THERE ARE NO MORE QUESTIONS IN THE EXAMINATION.

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GCSE MARKING SCHEME

SCIENCE - PHYSICS (LEGACY)

SUMMER 2012

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2012 examination in GCSE SCIENCE - PHYSICS (LEGACY). They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

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WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

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PHYSICS 1 (LEGACY)

FOUNDATION TIER

Question			Marking details	Marks Available
1.	*(a)*		Totally internally reflected (1) …more than… (1)	
	(b)		refracted (1) ….. less than…. (1)	4
			Question total	**[4]**
2.	*(a)*		Complete orbit drawn nearer the Earth's than to Saturn's.	1
	(b)	(i)	Jupiter, Uranus, or Neptune	1
		(ii)	Saturn is further from [the Sun] or Earth is closer.	1
	(c)	(i)	A collection of rocks [with sizes smaller than that of the smallest planet] in an orbit (1) around the Sun between the orbits of	
		(ii)	Mars and Jupiter (1) [could credit in (c)(i)]	2
			Question total	**[5]**
3.	*(a)*	(i)	Conduction (1)	
		(ii)	Convection (1)	2
	(b)		Glass fibre is a good insulator / traps air (1)	
			reduces heat loss / keeps more heat in (1)	2
			Question total	**[4]**
4.		(i)	Reduces heat / energy loss in the cables / not much voltage drop in the cables (1)	
		(ii)	Step-down transformers (1)	
		(iii)	To give a consistent / reliable supply [to everyone] / support for breakdowns etc (1)	3
			Question total	**[3]**
5.	*(a)*		[CO_2 produces] global warming / greenhouse effect (1)	
			[SO_2 produces] acid rain (1)	2
	(b)	(i)	Cooling required / prevents overheating / to produce steam (1)	
		(ii)	Transport of coal / fuel / removal of waste (1)	2
			Question total	**[4]**

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Question			Marking details	Marks Available
6.	*(a)*		Wasted energy = 1000 – 876 – 100 = 24 [J]	1
	(b)		Efficiency = $\frac{976}{1000} \times 100 = 97.6[\%]$ [976 (1) subs(1); ans (1)] Accept 98% [Award 2 marks only for answers of 10% / 87.6% / 97%] No **ecf** from (a)	3
			Question total	**[4]**
7.	*(a)*	(i) (ii)	wavelength = 4 [m] (1) amplitude = 50 [cm] (1)	2
	(b)		Frequency = $\frac{2.8}{4}$ = 0.7 [Hz] [subs (1); ans (1)] **ecf** from (a)(i)	2
			Question total	**[4]**
8.	*(a)*		0.5 [kW]	1
	(b)	(i)	No. of kWh = 0.5 **ecf** × 5 × 14 = 35 [Subs (1); ans (1)]	2
		(ii)	Cost = 35 **ecf** × 8 = 280 [p] / £2.80	1
	(c)	(i)	Less power / less energy / not as many Watts / less units of electricity	1
		(ii)	New cost = $\frac{1}{5}$ × 280 **ecf** [p] [or 0.1 × 5 × 14 × 8] = 56 [p](1) Saving = 280 – 56 **ecf** = 224 [p] [ans] (1)	2
			Question total	**[7]**
9.	*(a)*	(i)	Plastic / glass containers allow microwaves to pass through them (2) **or** metal containers reflect microwaves / produce sparks / don't allow microwaves to pass through them (2)	2
		(ii)	Microwave energy causes the <u>water</u> to be <u>heated</u> rapidly	1
	(b)		Any 2 × (1) from • different wavelength / frequency ✓ • greater penetration ✓ • ionises / damages cells of the body ✓ • transfer more energy ✓	2
			Question total	**[5]**

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Question			Marking details	Marks Available
10.	*(a)*	(i)	8 [hours]	1
		(ii)	10 [GW]	1
	(b)		A period of low demand from users	1
	(c)		Source of energy [falling water] at the flick of a switch or no time needed for the source to warm up	1
	(d)		Reduces base load / produces less power by closing down for maintenance or reducing output further	1
			Question total	**[5]**
11.	*(a)*		Gravitational attraction / gravity	1
	(b)		Both produced by fusion / hydrogen to helium or heavier elements / atoms forced together (1) with a release of [a large amount] of energy / heat and light (1)	2
	(c)		Balanced forces (1) Named forces (1)	2
			Question total	**[5]**
			Total Foundation paper	**50**

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PHYSICS 1 (LEGACY)

HIGHER TIER

Question			Marking details	Marks Available
1.	*(a)*	(i)	Plastic / glass containers allow microwaves to pass through them (2) **or** metal containers reflect microwaves / produce sparks / don't allow microwaves to pass through them (2)	2
		(ii)	Microwave energy causes the <u>water</u> to be <u>heated</u> rapidly	1
	(b)		Any 2 × (1) from • different wavelength / frequency ✓ • greater penetration ✓ • ionises / damages cells of the body ✓ • transfer more energy	2
			Question total	**[5]**
2.	*(a)*	(i)	8 [hours]	1
		(ii)	10 [GW]	1
	(b)		A period of low demand from users	1
	(c)		Source of energy [falling water] at the flick of a switch or no time needed for the source to warm up	1
	(d)		Reduces base load / produces less power by closing down for maintenance or reducing output further	1
			Question total	**[5]**
3.	*(a)*		Gravitational attraction / gravity	1
	(b)		Both produced by fusion / hydrogen to helium or heavier elements / atoms forced together (1) with a release of [a large amount] of energy / heat <u>and</u> light (1)	2
	(c)		Balanced forces (1) Named forces (1)	2
	(d)	(i)	19^{th}century model used the idea of chemical reaction / energy (burning) [produce the heat and light generated by the star] (1). A short finite life of a few thousand years was predicted (1)	2
		(ii)	Geologists discovered that the Earth was millions of years old.	1
			Question total	**[8]**

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Question			Marking details	Marks Available
4.	*(a)*	(i)	7 [kW] (1)	
		(ii)	3 [kW] (1)	2
	(b)		[Total] heat lost (10 kW) = [Total] heat gained (10 kW)	1
	(c)	(i)	Heat now lost by <u>convection</u> [as well as conduction and radiation] /more heat lost than gained. (1)	
		(ii)	Rad = 1.4 [kW] ;Cond = 4 [kW]; Conv = 8 [kW] [(1) for all readings correct] Total = 13.4 [kW] [(1) for the correct addition of 3 readings] x 1000 or presence of kW (1)	4
		(iii)	22 °C	1
			Question total	**[8]**
5.	*(a)*		% Efficiency = $\frac{168000(1)}{198000} \times 100$ = 84.8 [%] accept 85% / 84.85% Subs (1); Ans (1) [Award 2 marks for 84.84%]	3
	(b)		Energy = Power × time (1)	1
			198 000 = 2200 × time x1000 or /1000 (1) Time = $\frac{198000}{2200}$ = 90 [s] subs/manip (1); ans (1) Alternatives: $\frac{198}{2.2}$ = 90 [s] → 3 marks $\frac{168000}{2200}$ → 2 marks $\frac{168}{2.2}$ → 2 marks $\frac{198}{2200}$ → 1 mark $\frac{198000}{2.2}$ → 1 mark $\frac{168}{2200}$ → 0 marks	3
			Question total	**[7]**

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Question			Marking details	Marks Available
6.	*(a)*	(i)	Reduces convection [losses] / traps radiation	1
		(ii)	Black surfaces are <u>better / good absorbers of radiation / infra-red</u> so temperature increases.	1
	(b)	(i)	Maximum power = 2.4 [kW] (1) Minimum power = 0.96 [kW] (1) Award 1 mark for 2400 & 960 Award 1 mark for 4.8 & 1.92	2
		(ii)	Average of maximum and minimum powers shown **ecf** (1) 1.68 **ecf** x 10 = 16.8 [kWh] (1)	2
	(c)		Any 2 x (1) from: • Average power of sunlight greatly reduced in winter • Sunlight is available for less day time • Energy delivered much less • Outside temperature is colder • Water starts off colder so requires more heat to be supplied to it	2
			Question total	**[8]**
7.	*(a)*		Wave speed decreases as the frequency increases (1); non-linearly / inversely proportional (1)	2
		(b)	speed = $\frac{\text{distance}}{\text{time}} = \frac{311000}{12 \times 60 \times 60} = 7.20$ [m/s] Subs (1); conversion (1); ans (1) From graph speed = 7.20, frequency = 0.22 [Hz] (1) $v = f\lambda$, 7.22 = 0.22 **ecf** λ $\lambda = \frac{7.22}{0.22} = 32.73$ [m] Subs (1); manipulation (1); ans (1) No penalty for incorrect rounding throughout.	7
			Question total	**[9]**
			Total Higher Tier	**50**

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

0237/02

SCIENCE
HIGHER TIER
PHYSICS 1

P.M. MONDAY, 30 January 2012

45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**6**	
3.	**8**	
4.	**9**	
5.	**5**	
6.	**8**	
7.	**9**	
Total	**50**	

0237
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 of the examination paper. In calculations you should show all your working.

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EQUATIONS

power = voltage × current

energy transfer = power × time

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

cost = units used (kWh) × cost per unit

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

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

wave speed = wavelength × frequency

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}

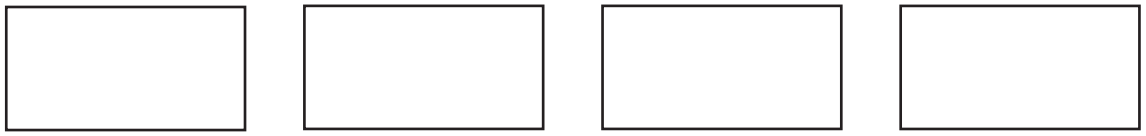
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Answer **all** *questions.*

1. **Visible light, X-rays, Infra-red radiation and Radio waves** are four members of the electromagnetic spectrum.

(a) Place these four radiations in the boxes below in the order of decreasing wavelength. [2]



Longest wavelength

Shortest wavelength

(b) State **two** practical uses of Infra-red radiation. [2]

1. .....

.....

2. .....

.....

(c) State how large doses of X-rays damage cells in the body. [1]

.....

.....

.....

5

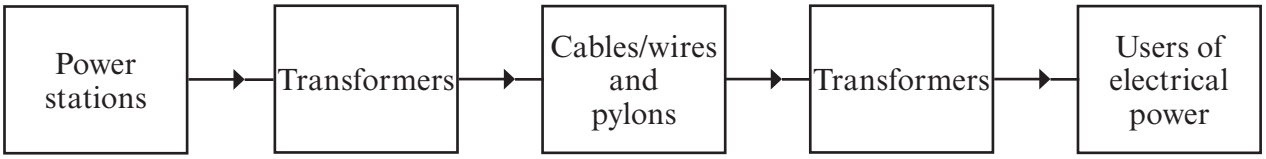
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Turn over.

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2. The National Grid is a network of cables and pylons which connects power stations together and supplies electricity to factories and homes across the country.
The block diagram shows the main parts of the National Grid.



(a) State an advantage of connecting power stations together. [1]

.....

.....

(b) (i) Give a reason why low resistance cables/wires are used for the transmission of electricity in the National Grid. [1]

.....

.....

(ii) Give a reason why the cables/wires that carry the power are held **high** above ground level. [1]

.....

.....

(c) State how and explain why both "step-up" and "step-down" transformers are used throughout the National Grid. [3]

.....

.....

.....

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.....

.....

6

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3. The information plate below was found on the back of a microwave oven.

Serial No. 7JAN300010X
240 V a.c. 50 Hz
0.8 kW
2450 MHz

(a) (i) Write down the power of the microwave oven in W. ..... [1]

(ii) Use the equation

energy transfer = power × time

to find how much energy is transferred by the microwave oven in 60 s. [2]

Energy transferred = ... J

(b) What does the figure 2450 MHz tell you about the microwaves? [1]

.....

.....

(c) Select an equation from page 2 and use it to calculate the wavelength of the microwave radiation used by the oven. The speed of electromagnetic radiation is 3×10^8 m/s.

Equation .....

.....

[1]

Calculation [3]

Wavelength = ... m

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4. In a pumped storage power station, water from a reservoir is allowed to fall through a pipe to a reservoir at a lower level.

When the water falls, it turns a turbine which is connected to a generator to produce electricity.

The generator produces an output of 20 000 V at 1000 A. The efficiency of the generation system is 75%.

(a) (i) Use the equation

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

to calculate the output power. [1]

Output power = ... W

(ii) Select an equation from page 2 and use it to calculate the input power delivered to the turbine generator by the falling water.

Equation .....

.....

[1]

Calculation [3]

Input power = ... W

(b) At night electricity is used to pump the water from the lower to the upper reservoir.

Explain why:

(i) this is done overnight; [1]

.....

.....

(ii) more electrical energy was needed for pumping than was generated when the station was operated during the day. [1]

.....

.....

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(c) Give clear reasons why pumped storage power stations are only used in short periods and at times of peak demand for electricity. [2]

.....

.....

.....

.....

9

5. *(a)* Write a brief account of the "death" of a **high-mass** star. [3]

.....

.....

.....

.....

.....

.....

.....

.....

(b) Explain how the "death" of stars produces an increase in the fraction of elements heavier than helium in the Universe. [2]

.....

.....

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.....

.....

5

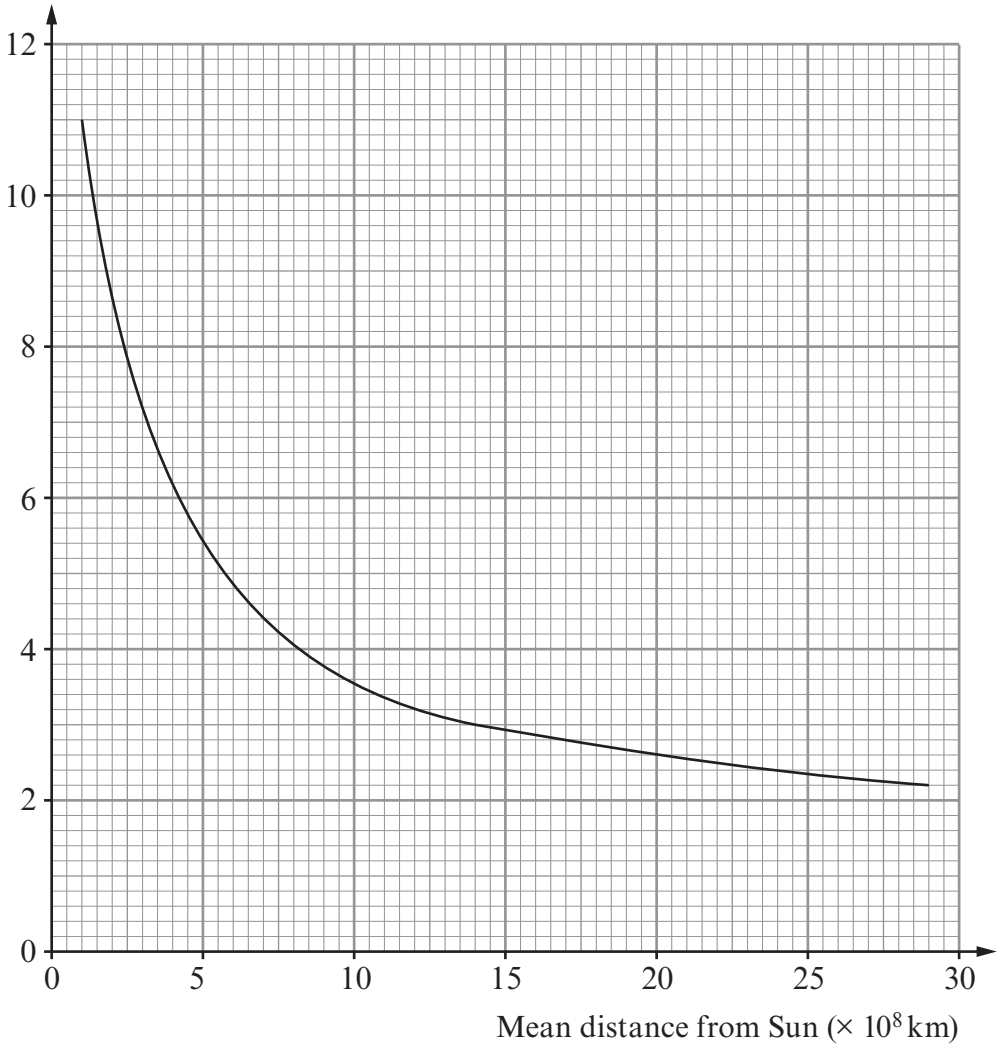
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6. The table below gives data on six planets in the Solar System.

Planet	Mean distance from the Sun ($\times 10^8$ km)	Mean surface temperature (°C)	Time for 1 orbit (years)
Venus	1.10	480	0.62
Earth	1.50	22	1.00
Mars	2.25	–23	1.88
Jupiter	7.80	–150	11.86
Saturn	14.00	–180	29.46
Uranus	29.00	–210	84.01

The graph shows how the orbital speed of the planets varies with their distance from the Sun.



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(a) What is the orbital speed of Saturn? ..... km /year [1]

(b) An asteroid Ceres is 700 km in diameter and has an orbital speed of 5.8×10^8 km/year. It travels 2.67×10^9 km in making one orbit of the Sun.

(i) Use the graph to find the distance of Ceres from the Sun. [1]

Distance = ... km

(ii) Use the equation

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

to find the orbital time of Ceres. [2]

Orbital time = ... yr

(c) Estimate the mean temperature on Ceres, showing your working or explaining how you arrived at your answer. [2]

Average temperature = ... °C

(d) Ceres is further from the Sun than Earth.
State **two** other reasons why it takes Ceres longer than Earth to complete one orbit of the Sun. [2]

1. .....

.....

2. .....

.....

8

Turn over.

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7. An uninsulated house has gas central heating and the energy cost for heating this house for a year was £940.

After installing double glazing, loft and cavity wall insulation, at a total cost of £5000, the heating bill for the following year was £640.

(a) (i) Calculate the payback time for the cost of the energy saving improvements. [2]

Payback time = ... years

(ii) Explain why the actual payback time may be shorter. [1]

.....

.....

.....

.....

(b) Give **two** environmental reasons why it is important to reduce heat losses from our homes. [2]

1. .....

.....

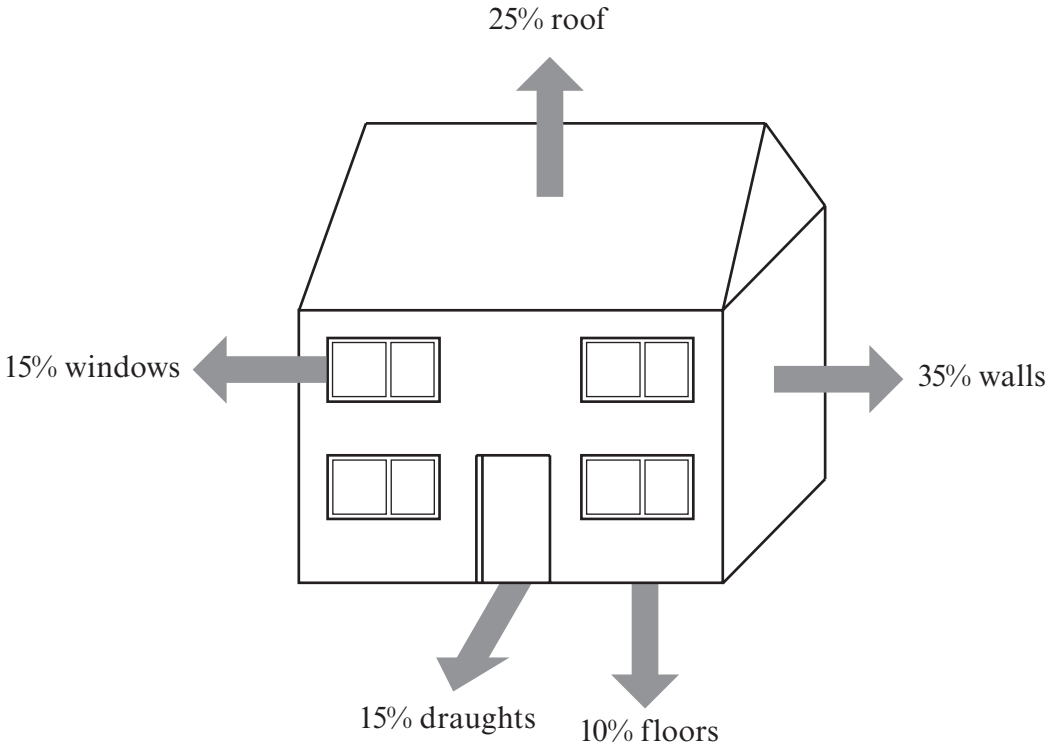
2. .....

.....

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(c) The diagram shows the percentage of energy lost through various places from the house **after** the energy saving improvements.



How many units of energy per year were **still** lost through the **insulated** cavity walls? You may assume that the cost of one unit of gas remained constant at 40p. [4]

Units = ...

9

THERE ARE NO MORE QUESTIONS IN THE EXAMINATION.

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GCSE MARKING SCHEME

SCIENCE – PHYSICS (LEGACY)

JANUARY 2012

INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2012 examination in GCSE SCIENCE – PHYSICS (LEGACY). They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

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Unit	Page
Physics 1 (Legacy) Foundation Tier	1
Physics 1 (Legacy) Higher Tier	4
Physics 2 (Legacy) Foundation Tier	7
Physics 2 (Legacy) Higher Tier	10

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PHYSICS 1 (LEGACY)

FOUNDATION TIER

Question			Answer / Explanatory Notes	Marks Available
1.			Line from 1 to Radiation Line from 2 to Conduction Line from 3 to Convection Line from 4 to Radiation	1 1 1 1 **4**
2.	(a)		400 – 215 – 105 = 80 (1)	1
	(b)		$\frac{320}{400} \times 100 = 80(\%)$ Subs (1) Ans (1) allow e.c.f. (0.8 award 1 mark)	2 **3**
3.	(a)	(i)	4865 – 2515 = 2350 (1)	1
		(ii)	Cost = 2350 × 40 Subs / Ans (1) allow e.c.f. = 94000 p = (£)940 Conversion to £ (1)	2
	(b)		$\frac{25}{100} \times 940$ (94000) = (£)235/ (23500) Subs (1) Ans (1) allow e.c.f	2 **5**
4.	(a)	(i)	8 (m/s) (1)	1
		(ii)	$f = \frac{v}{\lambda} = \frac{8}{40} = \frac{1}{5}$ or 0.2 (Hz) Subs (1) Ans (1) allow e.c.f.	2
	(b)		Speed – 4 m/s / slower (1) Freq – 0.4 Hz / greater (1) **Or** speed different (1) Frequency different (1)	2 **5**
5.			Disposal of waste Contamination of the water used for cooling Decommissioning time Meltdown / explosion Safety – needs to be qualified Transport of fuel to and from for reprocessing Risk of terrorist attack Pollution – needs to be qualified e.g. risk of leaks Any (3 × 1)	3 **3**

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Question			Answer / Explanatory Notes	Marks Available
6.	*(a)*		Fusion (1) Hydrogen **<u>to</u>** Helium / light elements to heavier elements (1)	2
	(b)	(i) (ii)	Explosion of a star (1) Stars of a high mass / big enough star (1)	2 **4**
7.	*(a)*	(i) (ii)	Electricity Has best value for cost per MJ / gets more energy for 50 p	1 1
	(b)	(i) (ii) (iii)	Cost of gas = £4 /400(p) (1) Number of MJ = 800 (MJ) (1) Cost using coal = £8/800 (p) (1) allow e.c.f.	3 **5**
8.	*(a)*		Venus	1
	(b)		Highest temperature (1) even though further from the Sun than Mercury / even though not the nearest planet to the Sun(1)	2
	(c)		12 × 413 Subs (1) 4956 million km [Answer (1) **Unit** (1)] Unit must match answer	3 **6**
9.	*(a)*		Radio waves in 1st LH box or X-rays in RH box (1) Correct sequence for remaining parts (1)	2
	(b)		Remote (controls) , thermal imaging, optical fibres, radiant heaters, burgular alarms, grilling/toasting, mobile phones Night lights, Heat treatment Any (2×1)	2
	(c)		X-rays ionises [molecules in] cells / damages DNA / mutates cells (1)	1 **5**

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Question			Answer / Explanatory Notes	Marks Available
10.	*(a)*		To maintain supply to customers when a breakdown occurs / changes in demand	1
	(b)	(i)	[Low resistance] to keep heat loss to minimum	1
		(ii)	High voltages are dangerous / stop people being eletrocuted / people can't touch them / can't get damaged	1
	(c)		'Step- up' to raise voltage (to a suitable level) (1) (for transmission) with minimum loss of energy (1) 'Step-down' to lower voltage to safe value for domestic use (1) Statement of value correctly used in transmission or domestic use, e.g. 132 000 V, 400 000 V 230[accept 240] V (1) **Award a maximum of 5 marks only for (b) and (c)**	3 **6**
11.	*(a)*	(i)	800 (W)	1
		(ii)	800 × 60 = 48000 (J) Or = 0.8 x 60 = 48 kJ Subs (1) Ans (1) allow e.c.f.	2
	(b)		This is the frequency of the radiation used / or correct definition of frequency	1 **4**

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HIGHER TIER

Question			Answer / Explanatory Notes	Marks Available
1.	*(a)*		Radio waves in 1st LH box or X-rays in RH box (1) Correct sequence for remaining parts (1)	2
	(b)		Remote (controls) , thermal imaging, optical fibres, radiant heaters, burgular alarms, grilling/toasting, mobile phones Night lights, Heat treatment Any (2×1)	2
	(c)		X-rays ionises [molecules in] cells / damages DNA /mutates cells (1)	1
				5
2.	*(a)*		To maintain supply to customers when a breakdown occurs / changes in demand	1
	(b)	(i)	[Low resistance] to keep heat loss to minimum	1
		(ii)	High voltages are dangerous / stop people being eletrocuted / people can't touch them / can't get damaged	1
	(c)		'Step- up' to raise voltage (to a suitable level) (1) (for transmission) with minimum loss of energy (1) 'Step-down' to lower voltage to safe value for domestic use (1) Statement of value correctly used in transmission or domestic use, e.g. 132 000 V, 400 000 V 230[accept 240] V (1) **Award a maximum of 5 marks only for (b) and (c)**	3
				6
3.	*(a)*	(i)	800 (W)	1
		(ii)	800 × 60 = 48000 (J) Or = 0.8 x 60 = 48 kJ Subs (1) Ans (1) allow e.c.f.	2
	(b)		This is the frequency of the radiation used / or correct definition of frequency	1
	(c)		Wave speed = wavelength × frequency [accept $v = f\lambda$]	1
			Use of 2450×10^6 Hz [or equiv] i.e. conversion (1) $\lambda = \frac{3\times10^8}{2450\times10^6} =$ 0.122 (m) Substitution (1) Manipulation with formula or numbers (1) ($\frac{3\times10^8}{50}$ award 1 mark only)	3
				8

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Question			Answer / Explanatory Notes	Marks Available
4.	*(a)*	(i)	20 000 × 1000 = 20000000 (W) / 20 MW / 20 000 kW	1
		(ii)	$\%\ \text{Efficiency} = \frac{\text{Useful power [transfer]}}{\text{Total power [input]}} \times 100$	1
			$75 = \frac{20\,000\,000}{\text{input power}} \times 100$ substitution (1) Input = 26.7 M(W) / 2.67×10^7 (W) / 27 M(W) manipulation from formula or numbers(1) answer (1) allow e.c.f.	3
	(b)	(i)	Less demand for electricity at night or by implication	1
		(ii)	Heat is also given to the water in pumping / reference to efficiency of pumps	1
	(c)		Low start-up time so instant energy to grid [need reference to quickness](1) Must reuse water so only a finite amount of energy can be generated each day.(1)	2
				9
5.	*(a)*		(When it runs out of fuel it will expand and cool) to become a red super giant (1) and then produce a supernova (1) leaving dense neutron star or black hole (1)	3
	(b)		Fusion occurring (1) with example explained e.g. helium fuses into heavier elements (1)	2
				5
6.	*(a)*		3 x 10^8 (km / year)	1
	(b)	(i)	4.5 x 10^8 (km)	1
		(ii)	$\text{time} = \frac{2.67 \times 10^9}{5.8 \times 10^8} = 4.6$ (yr) Substitution (1) Answer (1)	2
	(c)		Ceres by value of distance from Sun and an orbit time is between Mars + Jupiter (1) Temperature – 50 (°C) to -100 (°C) (1) allow e.c.f. from (b)(i) Or some mathematical way of working it out based on the distances of Mars +Jupiter + Ceres from the Sun or on orbital times. (2 e.c.f. marks can be obtained from (b)(ii))	2
	(d)		Travels more slowly (1) and has further to go (1)	2
				8

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Question			Answer / Explanatory Notes	Marks Available
7.	*(a)*	(i)	Saving = 940 – 640 = £300 (1) Payback = $\frac{6000}{300}$ (1) for substitution = $16\frac{2}{3}$ (yrs)	2
		(ii)	Costs may increase or decrease, weather may change (colder not hotter)	1
	(b)		Less power generated Less fuels used Smaller carbon footprint / less greenhouse effect less acid rain Any (2 × 1)	2
	(c)		Cost = no. of units x cost of 1 unit £640 = no. of units x 40p No. of units = $\frac{640 \times 100(1)}{40}$ = 1600 (1) No. lost through cavity = $\frac{35}{100}$ (1) × 1600 = 560 (1) allow e.c.f. 2 marks available for correct methodology (£224 is 35% of £640 award 2 marks)	4
				9

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

237/02

SCIENCE
HIGHER TIER
PHYSICS 1

P.M. FRIDAY, 17 June 2011

45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**7**	
2.	**9**	
3.	**4**	
4.	**9**	
5.	**5**	
6.	**8**	
7.	**8**	
Total	**50**	

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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.

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EQUATIONS

power = voltage × current

energy transfer = power × time

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

cost = units used × cost per unit

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

wave speed = wavelength × frequency

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

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}

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Examiner only

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]

.....

.....

(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]

.....

.....

(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

7

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Turn over.

Examiner only

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	3000
	Fibre glass laid on floor of attic	400
CAVITY WALL	Non insulated	2000
	Insulated with foam	700
WINDOWS	Single glazed	2000
	Double glazed	1200

(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]

.....

.....

.....

.....

(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]

.....

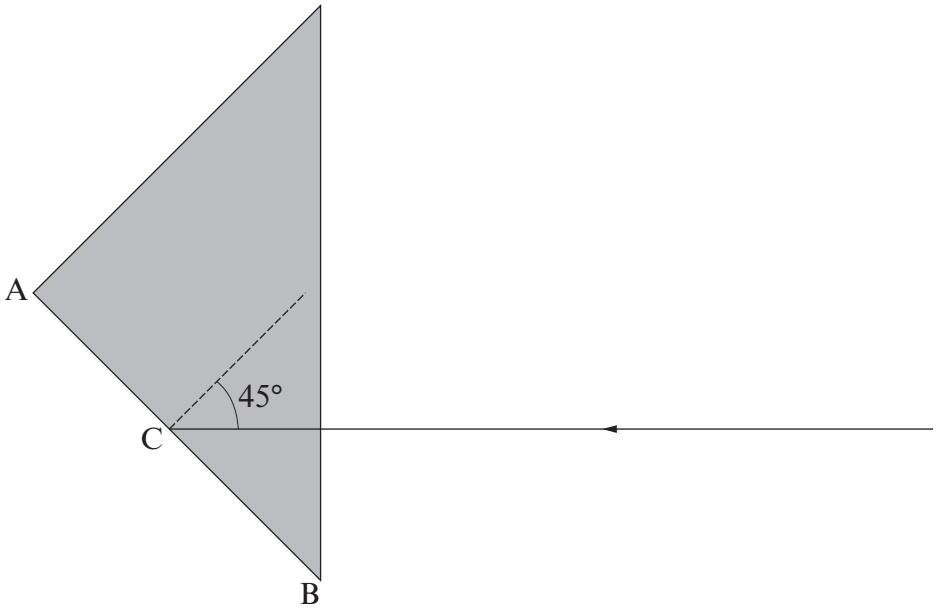
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3. A reflector on the back of a bicycle is made up of many glass prisms, one of which is shown in the diagram.
A ray of light strikes the back surface of the prism at point C at an angle of 45°.
The critical angle for glass is 42°.



(a) (i) Explain why the light does not leave the prism at point C. [1]

.....

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

.....

.....

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

4

Turn over.

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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]

.....

.....

(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]

.....

.....

.....

.....

(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 = ...

9

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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]

.....

.....

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

.....

.....

.....

.....

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

.....

.....

.....

.....

5

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Turn over.

Examiner only

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]

.....

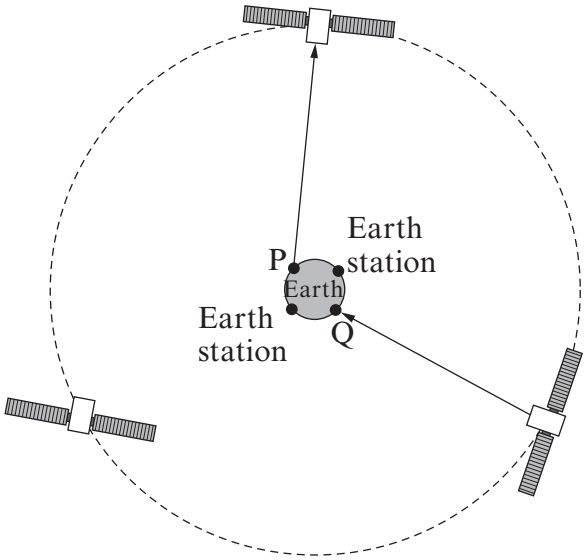
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.....

(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 = ...

8

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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]

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

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

8

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Candidate Name	Centre Number	Candidate Number
		0

GCSE

237/02

SCIENCE
HIGHER TIER
PHYSICS 1

A.M. WEDNESDAY, 19 January 2011

45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark awarded**
1.	**5**	
2.	**7**	
3.	**12**	
4.	**7**	
5.	**12**	
6.	**7**	
Total	**50**	

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020001

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator.

INSTRUCTIONS TO CANDIDATES

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Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

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INFORMATION FOR CANDIDATES

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EQUATIONS

power = voltage × current

energy transfer = power × time

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

cost = units used (kWh) × cost per unit

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

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

wave speed = wavelength × frequency

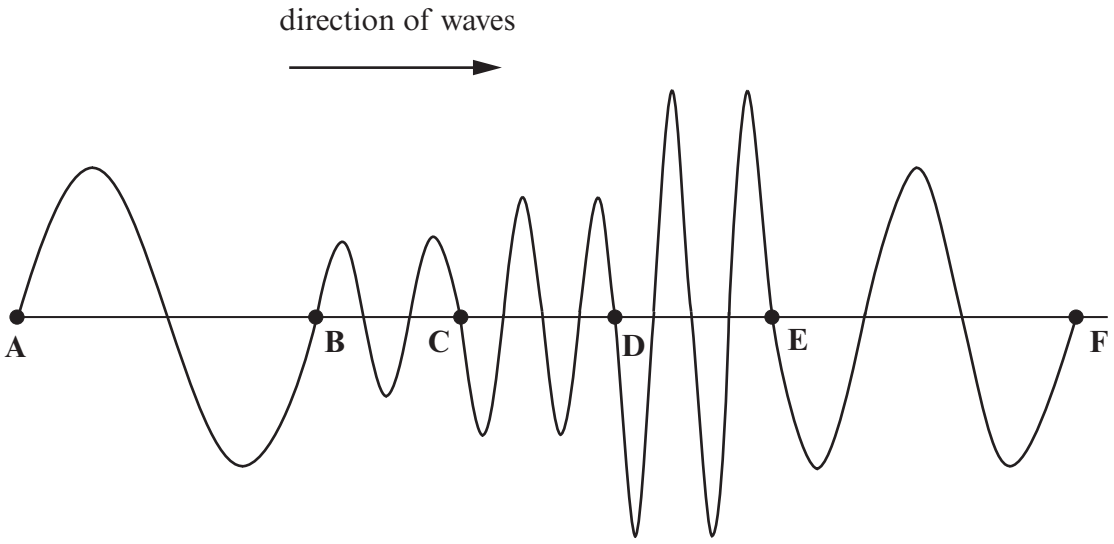
Commonly used prefixes			
Multiplier	Symbol	Meaning	
Micro	μ	0.000 001	10^{-6}
Milli	m	0.001	10^{-3}
Centi	c	0.01	10^{-2}
Kilo	k	1 000	10^{3}
Mega	M	1 000 000	10^{6}
Giga	G	1 000 000 000	10^{9}

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Answer **all** *questions.*

1. The diagram shows a train of waves.



(a) How many waves are shown between A and C? ..... [1]

(b) **Between which two of the points**, A, B, C, D, E and F is

(i) the wavelength biggest? .....

(ii) the amplitude smallest? ..... [2]

(c) (i) The eight waves between A and F cover a distance of 240 cm.
Calculate the **average** wavelength of the waves. [1]

Average wavelength = ... cm

(ii) The frequency of these waves is 10 Hz.

Use the equation:

Wave speed = wavelength × frequency

to calculate the average speed of these waves. [1]

Wavespeed = ... cm/s

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2. A number of windfarms are due to be built around Britain in the near future. The following table shows where they are to be built. The highlands of Scotland which are some of the windiest places in Britain face the Atlantic Ocean.

WINDFARMS BEING BUILT FOR FUTURE USE				
Location	Onshore (on land)		Offshore (at sea)	
	Number	Total power output (MW)	Number	Total power output (MW)
England	3	21	5	1450
Northern Ireland	1	20	0	0
Scotland	18	810	0	0
Wales	3	33	0	0
Totals	**25**	**884**	**5**	**1450**
Average power output		**35.4**		**290**

Source: *Information adapted from: http://www.bwea.com/statistics*

(a) In which part of Britain is the largest number of windfarms due to be built?

..... [1]

(b) Give **two** reasons why offshore wind farms are expected to produce much more energy than onshore wind farms. [2]

.....

.....

.....

.....

(c) Calculate the average (mean) power expected from the Scottish wind farms. [2]

Average (mean) power = ... MW

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(d) Give **two** objections that could be used against the plans to build offshore wind farms. [2]

.....

.....

.....

.....

.....

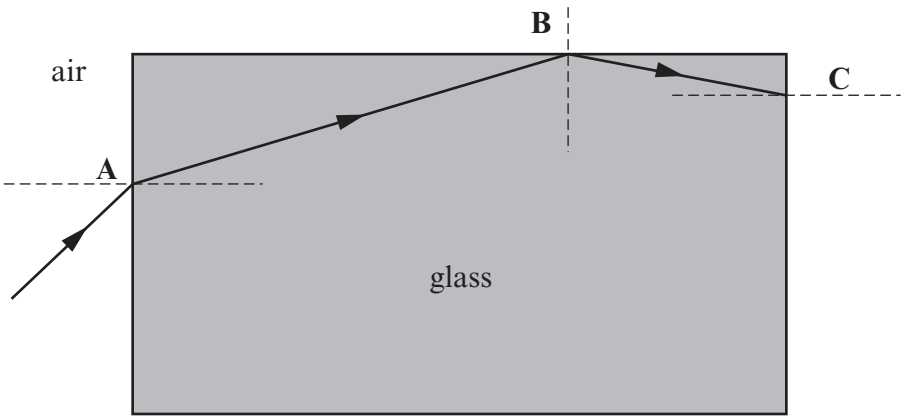
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3. The diagram shows light travelling from air into a glass block.



(a) (i) What name is given to the bending of light at point **A**? ..... [1]

(ii) Give a reason why the light changes direction at **A**. [1]

.....

.....

(b) State what is happening to the light at point **B**. [1]

.....

(c) At point **C**, the light passes out into the air.

(i) Give **one** reason why it does not go back into the block as it does at point **B**. [1]

.....

.....

(ii) **Draw** the ray direction into the air at point **C**. [1]

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(d) A long and very thin glass block becomes an optical fibre.

(i) Name a type of the electromagnetic radiation (other than visible light) that can be used to send messages along an optical fibre. [1]

.....

(ii) State **two** advantages of passing signals along optical fibres rather than using electrical signals in wires. [2]

1. .....

.....

2. .....

.....

(iii) The speed of signals along optical fibres is 2.0×10^8 m/s. Write down an equation from page 2 and use it to find the time that a signal would take to travel from London to New York along an optical fibre if the distance is 4.8×10^7 m.
Give the correct unit for your answer.

Equation: .....

..... [1]

Calculation: [3]

Time = ... Unit: .....

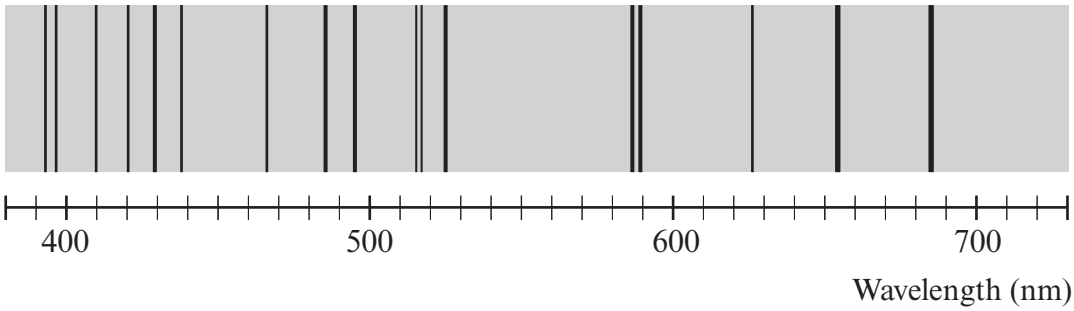
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4. *(a)* Describe how stars are created and start to produce energy. [3]

(b) The spectrum of white light (ROYGBIV) from the Sun has dark lines in it showing the presence of gases in the Sun's atmosphere. The diagram shows some of the more prominent lines.



Explain how the study of spectral lines from galaxies has led to the theory of the Big Bang. [4]

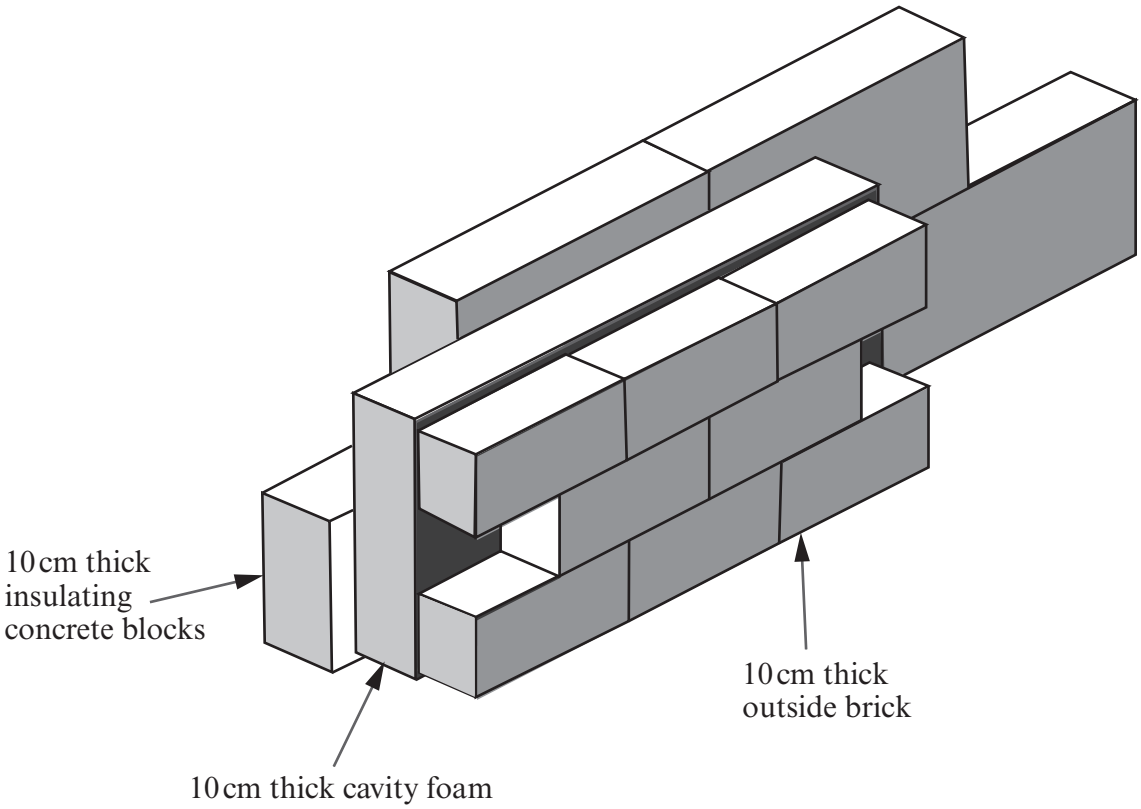
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5. A house wall is built in the way shown below. Its cavity is totally filled with foam.



The insulating effectiveness of a material is given by a quantity called its R value.
The R values for some common materials are shown in the table below.
R values just add together to give the total R value.

Material	R value (Units)
Air that is free to move	0.02
10 cm-thick attic fibre glass	2.40
A standard 10 cm thick brick	.....
10 cm cavity wall insulating foam	3.60
10 cm thick insulating concrete block	2.08
Total R value for <u>this type</u> of wall	**6.0**

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

(i) State why cavity wall insulation reduces the heat lost from a house. [1]

.....

.....

(ii) The total R value for the wall is 6.0. Calculate the R value for the brick. [1]

R value for brick = ... units

(b) The power lost through the wall is given by the following equation.

$$\text{Power lost (W)} = \frac{\text{Outside wall area} \times \text{temperature difference between inside and outside}}{\text{Total R value}}$$

A typical house has a total outside wall area of $300\,m^2$.
On a winter's day, the temperature outside is $-4°C$ and the inside is kept at $21°C$.

(i) Use the equation above to calculate the power lost from the house. [2]

Power = ... W

(ii) Use the following equations to find the cost of maintaining the inside temperature at 21°C for 24 hours if the cost of a unit of electricity is 12p. [4]

Units used (kWh) = power (kW) × time (h)
Cost = units used × cost per unit

Cost = ...

(iii) Why would a semi detached house prove to be cheaper to heat than a detached house of similar size? [1]

.....

.....

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(c) The attic of a house is a major source of heat loss. This can be reduced by laying fibre glass on the attic floor.

(i) The R value of a well-insulated attic should be at least 7.2. Calculate the minimum thickness of fibre glass that is required. [1]

Thickness = ... cm

(ii) Explain how fibre glass reduces heat transfer through the attic. [2]

.....

.....

.....

.....

.....

12

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6. A coal-fired power station is 34.3% efficient. It has a power output of 1200 MW which it supplies to the national grid.

(a) Write down an equation from page 2 and use it to calculate the power input to the power station.

Equation: .....

..... [1]

Calculation: [3]

Power = ... MW

(b) The output power is shared equally between 10 power lines. Step-up transformers are used to raise the voltage to 440 000 Volts.
Use the equation

$$\text{current} = \frac{\text{power}}{\text{voltage}}$$

to calculate the current in **each of** the overhead power lines. [3]

Current in each power line = ... A

7

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