Candidate Name	Centre Number					Candidate Number				
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GCSE

SCIENCE (Double Award)

UNIT 3: (Double Award) PHYSICS 1
HIGHER TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 15 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.	**12**	
3.	**12**	
4.	**11**	
5.	**11**	
6.	**8**	
Total	**60**	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
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.
Question **6(i)** is a quality of extended response (QER) question where your writing skills will be assessed.

Equations

current = $\frac{\text{voltage}}{\text{resistance}}$	$I = \frac{V}{R}$
total resistance in a series circuit	$R = R_1 + R_2$
total resistance in a parallel circuit	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$
energy transferred = power × time	$E = Pt$
power = voltage × current	$P = VI$
power = current^2 × resistance	$P = I^2R$
$\%\ \text{efficiency} = \frac{\text{energy [or power] usefully transferred}}{\text{total energy [or power] supplied}} \times 100$	
$\text{density} = \frac{\text{mass}}{\text{volume}}$	$\rho = \frac{m}{V}$
units used (kWh) = power (kW) × time (h) cost = units used × cost per unit	
wave speed = wavelength × frequency	$v = \lambda f$
$\text{speed} = \frac{\text{distance}}{\text{time}}$	

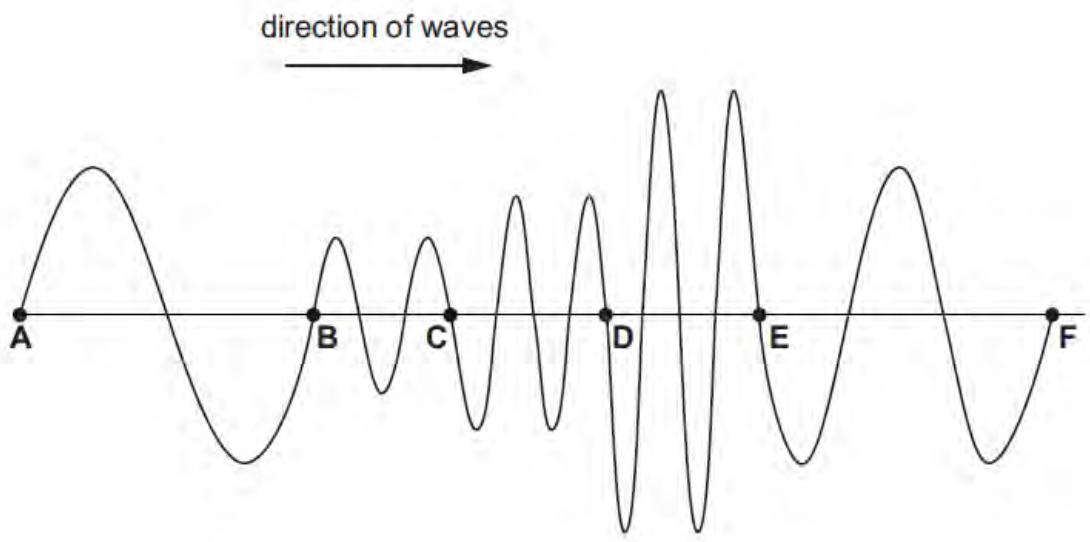
SI multipliers

Prefix	Multiplier
p	1×10^{-12}
n	1×10^{-9}
μ	1×10^{-6}
m	1×10^{-3}

Prefix	Multiplier
k	1×10^{3}
M	1×10^{6}
G	1×10^{9}
T	1×10^{12}

*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 longest? ……. [1]

(ii) the amplitude smallest? …….. [1]

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

mean wavelength = …….. cm

(d) The diagram shows transverse waves. Describe what a transverse wave is. [2]

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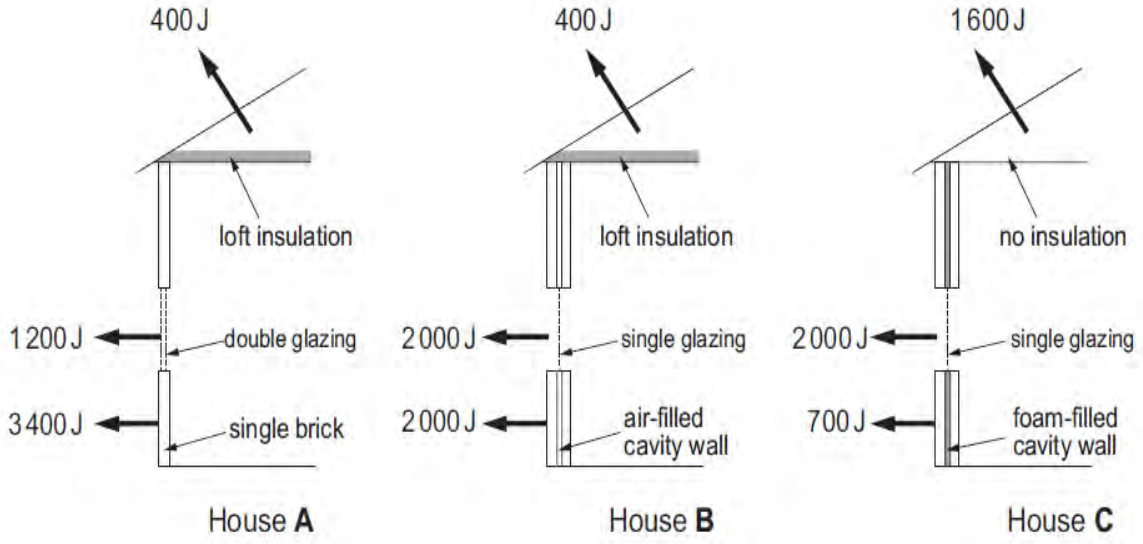
6

2. There are several factors to consider when you are looking at choosing the best heating system for your home. These include the amount of heating needed, the running costs and the environmental impact of the different heating options. Before looking at your heating, get your insulation sorted. Good quality, well installed insulation helps keep the heat in during winter. This makes your house easier and cheaper to heat properly.

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 tick (✓) the correct statements in the list below. [3]
Space for workings if needed.

A single brick wall loses the least energy per second ☐

House **B** loses the least energy per second ☐

Adding loft insulation reduces heat loss by 1 200 J/s ☐

Before house **C** had its cavity walls filled with foam it was losing 5 600 J/s ☐

The most effective method of reducing energy loss is to install double glazing ☐

If house **C** had double glazing installed its energy loss would reduce to 3 500 J/s ☐

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

……

(ii) Name the **two** processes by which heat is lost through the ceiling and the roof space. [2]

……..

(iii) Explain how loft insulation reduces heat loss through the roof of houses **A** and **B**. [3]

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…….

(c) (i) Give a reason 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) Explain the 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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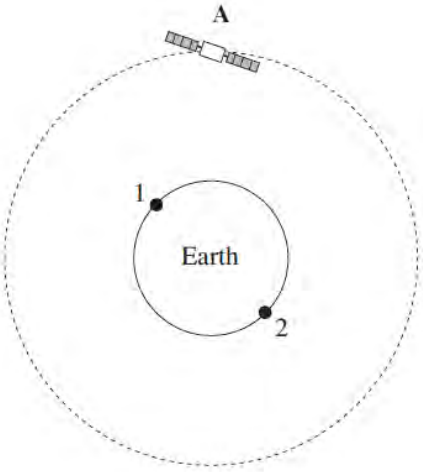
12

3. A satellite is an object that *orbits* a larger object in space. The Earth has many artificial satellites in orbit around it. These have been built by people and launched into orbit using rockets. Some very large artificial satellites were put into orbit by the American Space Shuttle. Artificial satellites have different orbits. Satellites in lower orbits travel faster than those in higher ones. The higher the orbit of a satellite, the longer its 'period' (time to make one orbit).

Geostationary satellites are in orbit above the *equator*. Geostationary satellites have uses such as communications including satellite TV and global positioning or GPS - which is used for satellite navigation systems. A single geostationary satellite is on a line of sight with about 40% of the Earth's surface. Three such satellites, each separated by 120^{o} of longitude, can provide coverage of the entire planet, with the exception of small circular regions centered at the north and south geographic poles.

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



(a) (i) Explain the advantages of placing communications satellites in geosynchronous orbit. [3]

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

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

(b) (i) Communications between geosynchronous satellites and the Earth are made using microwaves of wavelength 20 cm that travel at 3×10^8 m/s.
Use an equation from page 2 to calculate the frequency of the microwaves. [3]

frequency = ……Hz

(ii) The time delay between sending a signal from radio station 1 and its reception at radio station 2 is 0.48 s.
Use an equation from page 2 to find the approximate height of geostationary satellites above the Earth. [3]

height above Earth = …… m

12

4. Homeowners who generate electricity from solar power get paid for energy they produce under a scheme called 'Feed-in Tariff' (FIT). They are paid for the energy they produce and use themselves this is the FIT. They are also paid an export tariff for any electricity they do not use but instead they put into the National Grid. They will also see their energy bills fall slightly.

The FIT return for a typical household installation is 12 p/kWh.
The export tariff is 5 p for every kWh fed into the National Grid.
The householder also saves 16 p from every kWh produced by the panels which they use and do not need to get from the National Grid.

Domestic systems tend to range from 1 kW to 5 kW in size. Each 1 kW system can produce roughly 850 kWh per year so a 2 kW system would create around 1 700 kWh and a 5 kW system would create 4 500 kWh. The Energy Saving Trust estimates that a typical 3-bedroom house in the UK uses 3 000 kWh in a year.

Roof area (m^2)	**Typical system maximum power output (kW)**	**Estimated cost (£)**	**Estimated annual energy output (kWh)**
7	1	3 500	840
14	2	5 000	1 680
21	3	6 000	2 520
28	4	7 000	3 360

Use the information above to answer the following questions.

(a) (i) Calculate the annual energy output per m^2 of panel. [2]

energy output = …… kWh

(ii) Describe the relationship between the roof area and estimated annual energy output. [2]

……..

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(iii) A householder installs 28 m^2 of panels. During the first year, they use 3 000 kWh themselves and export the remainder to the National Grid. Calculate the money gained. [4]

saving …….

(b) A solar panel manufacturer claims that their solar panels always produce an annual energy output of 200 kWh per m^2. Discuss why this claim cannot be true. [3]

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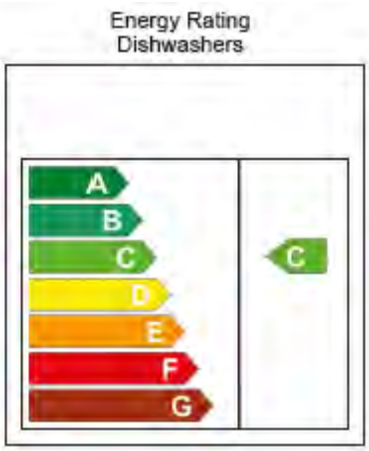
11

5. Dishwashers are rated by the amount of energy they use. Dishwashers rated **A** use less energy and are cheaper to run than those rated **G**.



For the following questions assume that all dishwashers are used for the same amount of time.

The following table gives information about dishwashers rated **A**, **B** and **D**.

Dishwasher energy rating	Voltage (V)	Current (A)	Units of energy used per year (kWh)
A	230	4	210
B	230	6	315
D	230	8	420

(a) Use an equation from page 2 to calculate the power of dishwashers rated **D**. [2]

power = …….. W

(b) Estimate the units of energy used per year by a dishwasher rated **C**. [1]

…….. kWh

(c) A homeowner buys a dishwasher rated **D**.

(i) Use an equation from page 2 to find the cost of using this dishwasher for a year. One unit of electricity costs 20 p. [2]

cost = £ ……..

(ii) The homeowner could have bought a dishwasher rated **A** that was £35 more than the one rated **D**. Explain why the dishwasher rated **A** would have been more cost effective. [3]

……

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……

(d) Use an equation from page 2 and the information in the table opposite and your answer to part (a), to calculate the time that the dishwasher rated **D** is used during a year. [3]

time = ……

11

6. (i) Describe how you would investigate the current-voltage (I-V) characteristics for a diode. [6 QER]

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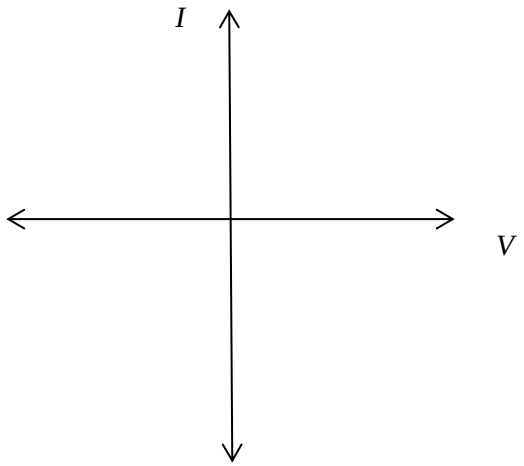
(ii) Sketch the I-V graph for a diode on the axes below that you would expect from the results. [2]



8

END OF PAPER