Candidate Name	Centre Number					Candidate Number				
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GCSE

SCIENCE (Double Award)

UNIT 3: (Double Award) PHYSICS 1
FOUNDATION TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 15 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**9**	
2.	**11**	
3.	**10**	
4.	**9**	
5.	**6**	
6.	**6**	
7.	**9**	
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 **5** is a quality of extended response (QER) question where your writing skills will be assessed.

Equations

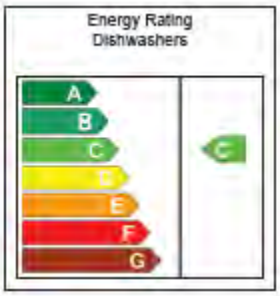
current = $\frac{\text{voltage}}{\text{resistance}}$	$I = \frac{V}{R}$
total resistance in a series circuit	$R = R_1 + R_2$
energy transferred = power × time	$E = Pt$
power = voltage × current	$P = VI$
% efficiency = $\frac{\text{energy [or power] usefully transferred}}{\text{total energy [or power] supplied}} \times 100$	
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	$v = \lambda f$
speed = $\frac{\text{distance}}{\text{time}}$	

SI multipliers

Prefix	Multiplier
m	1×10^{-3}
k	1×10^{3}
M	1×10^{6}

Answer ***all*** questions

1. 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 the equation:

power = voltage × current

to calculate the power of dishwashers rated **D**. [2]

power = …….. W

(b) **Circle** from the list below, the energy used per year (kWh) by a dishwasher rated **C**. [1]

200 310 350 430

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

(i) Use the equation:

cost = units used × cost per unit

to find the cost of using this dishwasher for a year. One unit of electricity costs 20 p. [2]

cost = £ ……..

(ii) Complete the following sentence by underlining the correct words in the brackets. [1]

The dishwasher rated **A** costs (**half as much as** / **the same as** / **more than**) the dishwasher rated **D** to run.

(iii) The homeowner could have bought a dishwasher rated **A** that cost £35 more than the one rated **D**. State **one** reason why the dishwasher rated **A** would have been more cost effective. [1]

…….

…….

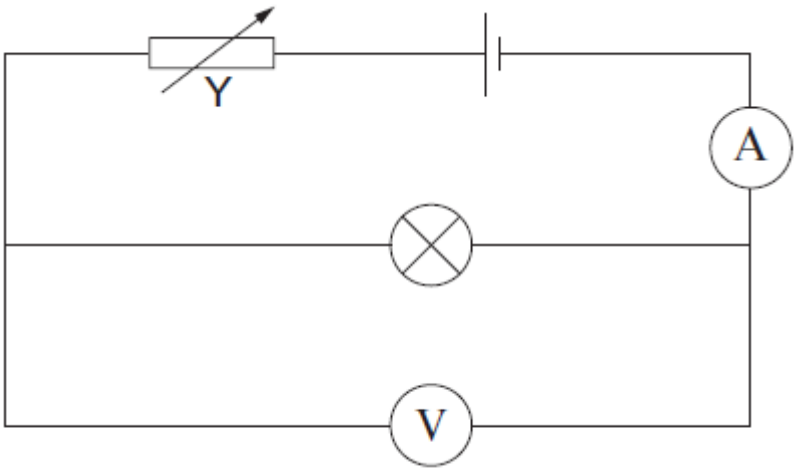
(d) Use the information in the table and your answer to part (a), to calculate the time that the dishwasher rated **D** was used during a year. [2]
Use the equation below:

$$\text{time(h)} \quad \frac{\text{units used(kWh)}}{\text{power(kW)}}$$

time = …….. h

9

2. A group of students set up the circuit below to investigate how the current in a lamp changes with the voltage across it.



(a) (i) Name component **Y**. ..... [1]

(ii) State the purpose of **Y**. [1]

.....

(iii) Describe how a set of results are obtained. [2]

.....

.....

.....

(b) They connect an identical lamp in series between the cell and the ammeter.

(i) State how this affects the resistance of the circuit. [1]

.....

(ii) State how this affects the current in the circuit. [1]

.....

(iii) State how this affects the reading on the voltmeter. [1]

.....

(c) They connect an identical lamp in parallel with the first lamp.

(i) **Add** this lamp to the circuit diagram above. [1]

(ii) State how this affects the resistance of the circuit. [1]

.....

(iii) State how this affects the current in the circuit. [1]

……

(iv) State how this affects the current in the first lamp. [1]

……

11

3. 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. The Energy Saving Trust estimates that a typical 3-bedroom house in the UK uses just over 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	……
28	4	7 000	3 360

Use the information above to answer the following questions.

(a) (i) **Complete the table**. [1]

(ii) Calculate the annual energy output for each m^2 of the panel with an area of 7 m^2. [2]

energy output = …….…… kWh

(b) 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.

(i) How much energy is exported to the National Grid? [1]

energy = …… kWh

(ii) Calculate the income the householder receives from the export tariff. [2]

income = …….

(iii) Calculate the money saved by the householder by generating this amount of energy. [2]

money saved = …….

(c) Give **two** reasons why the annual energy output from a particular solar panel can only be estimated. [2]

1 ……

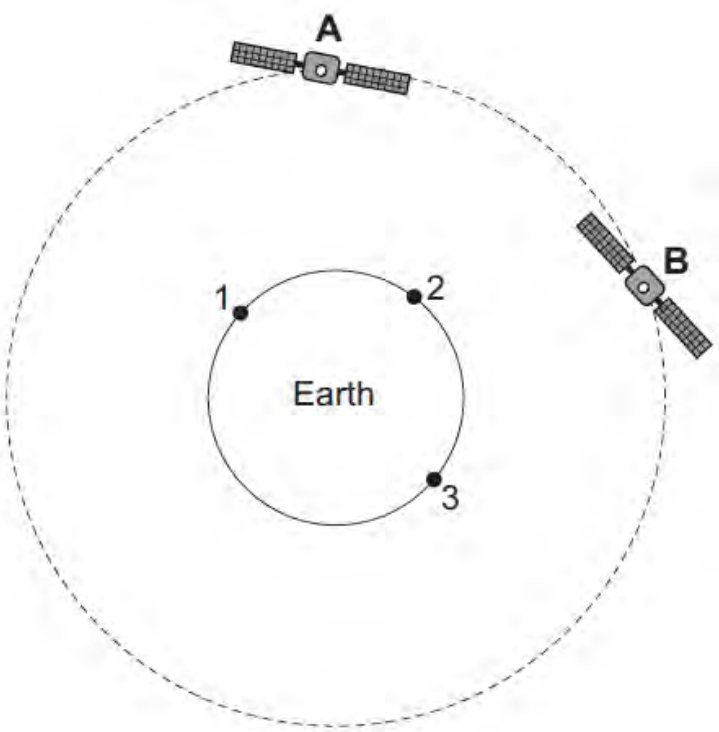
……

2 ……

……

10

4. The diagram below shows two communications satellites **A and B** in geosynchronous (geostationary) orbit around the Earth. The diagram is not to scale.



(a) Underline the correct word(s) in the brackets to complete the sentences. [3]

(i) A geosynchronous satellite orbits the Earth once every (**24 h** / **month** / **year**).

(ii) A geosynchronous satellite orbits above the (**North Pole** / **UK** / **equator**).

(iii) Satellites communicate using (**infra-red** / **visible light** / **microwaves**).

(b) **Show on the diagram** the path taken by the signal, via the satellites A and B, when radio station **1** communicates with radio station **3**. [2]

(c) Communications between geosynchronous satellites and the Earth are made using electromagnetic waves of wavelength 0.20 m that travel at 300 000 000 m/s.

(i) Calculate the frequency of these waves using the equation: [2]

$$\text{frequency} = \frac{\text{velocity}}{\text{wavelength}}$$

frequency = ……. Hz

(ii) The time delay between sending a signal from radio station **1** to satellite A is 0.12 s. Calculate the height of satellite A above the Earth using the equation: [2]

distance = velocity × time

height above Earth = ……. m

9

5. **Generators** produce electricity in coal, gas, oil, nuclear and hydroelectric power stations and wind farms. Electricity can't be stored efficiently so is generated as needed. When we watch television, turn the lights on or charge our smartphone, we rely on electricity that has passed across the National Grid. Once electricity is generated and enters the National Grid, the network needs to 'balance', ensuring supply and demand are matched second by second. As older power stations are decommissioned then new ones need to be developed.

The table shows some of the information planners use to help them decide on the type of power station they will allow to be built.

How they compare		
	A wind turbine	A nuclear power station
Maximum power output (MW)	3.6	3 600
Lifetime (years)	15	50
Commissioning cost (£ millions)	4	4 000
Waste	none	Radioactive waste
Lifetime carbon footprint (g of CO_2 / kWh)	4.8 onshore and 5.2 offshore	5

Use the information in the table and your knowledge to decide which method of generating electricity they should recommend. [6 QER]

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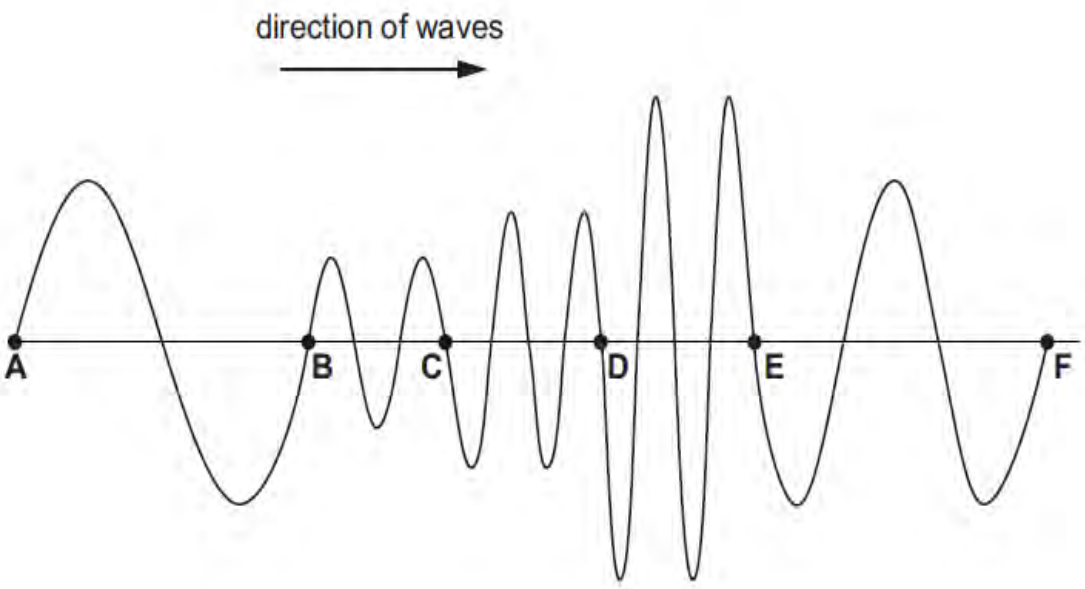
6. The diagram shows a train of waves.



(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]

.....

.....

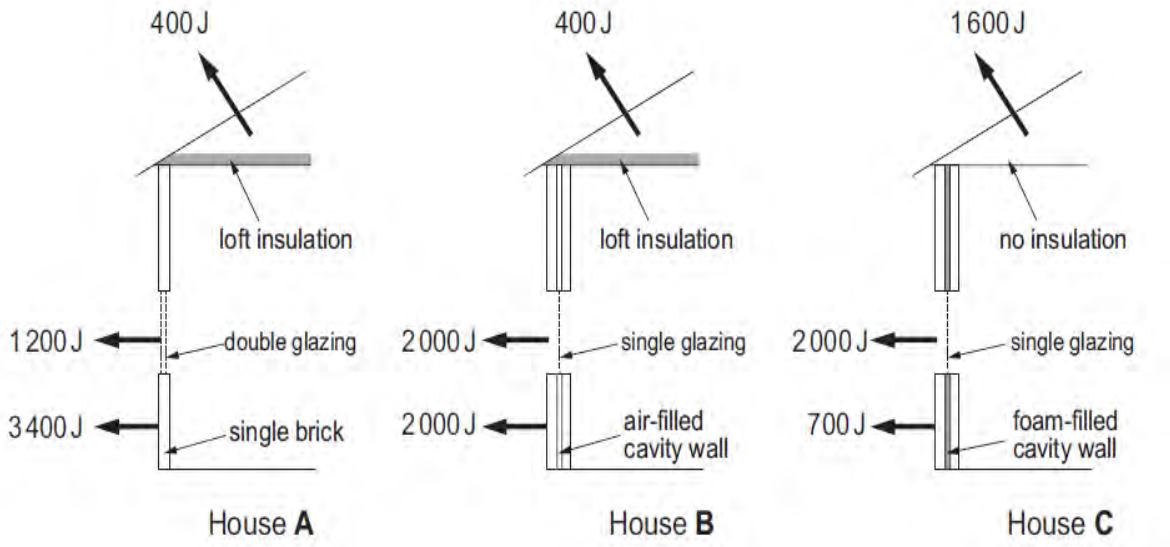
.....

.....

6

7. 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]

……..

(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]

…….

…….

…….

…….

9

END OF PAPER