Surname	Centre Number	Candidate Number
Other Names		0

wjec cbac

GCSE

3430UC0-1

S19-3430UC0-1

SCIENCE (Double Award)

Unit 3 – PHYSICS 1
HIGHER TIER

FRIDAY, 14 JUNE 2019 – MORNING

1 hour 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**15**	
2.	**8**	
3.	**6**	
4.	**14**	
5.	**9**	
6.	**8**	
Total	**60**	

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ADDITIONAL MATERIALS

In addition to this paper you will require a calculator and a ruler.

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. If you run out of space, use the additional pages at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

The assessment of the quality of extended response (QER) will take place in question **3**.

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	$P = I^2R$
% efficiency = $\frac{\text{energy (or power) usefully transferred}}{\text{total energy (or power) supplied}}$ × 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
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}

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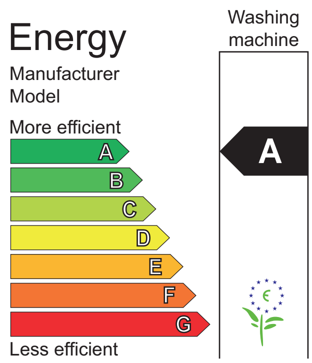
Answer **all** *questions.*

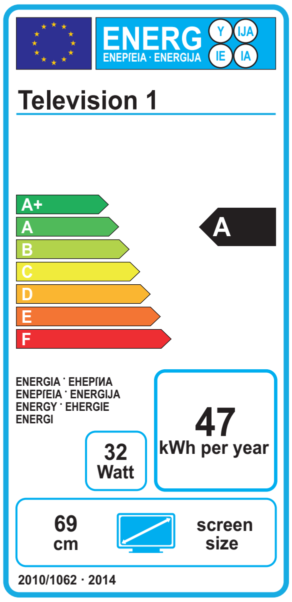
1. Energy rating labels are compulsory on most household appliances such as fridges, dishwashers, washing machines and televisions. These labels allow customers to compare appliances. In addition, the labels give other information about the appliances such as how noisy they are.

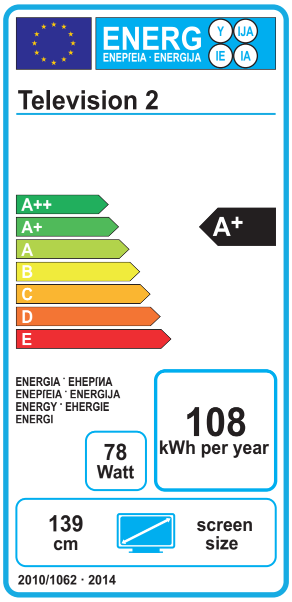
Labels used to rate appliances are from A, the most efficient, to G, the least efficient.



As manufacturers have designed more efficient devices, new categories, e.g. A+, A++ and A+++ have been added to the labels.

The energy rating labels of four televisions are given below and opposite.





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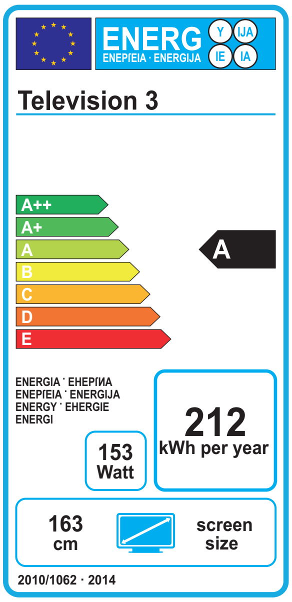

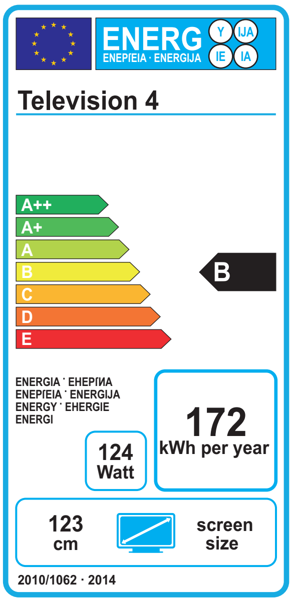

Information on the cost of each television is given below.

Television	Purchase cost (£)
1	280
2	1 000
3	1 500
4	800

(a) Use the information from the labels and the table to tick (✓) the **three** correct statements below. [3]

Statement	
Television **1** uses less energy per second than television **2**	☐
The largest televisions always use the most energy	☐
The purchase cost of television **2** is 1.5 times that of television **3**	☐
More expensive televisions always use less energy	☐
Television **3** uses 40 units more per year than television **4**	☐
Televisions with the same energy rating, e.g A+, don't always have the same power	☐

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(b) It is claimed that power is proportional to screen size. Use the data for television **1** and television **2** to determine if this claim is true. [3]
Space for calculations.

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(c) (i) Use the equation:

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

and data from the energy label to calculate how many hours the label suggests that television **2** is used for in 1 year. [2]

Hours used = ...

(ii) Use an equation from page 2 to calculate the cost of using television **2** for 1 year if 1 unit (kWh) of electricity costs 16 p. Give your answer in pounds (£). [2]

Cost = £ ....

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(iii) The expected lifespan of a television is 10 years. Simon concludes that it will be more cost effective to buy and run television **2** for 10 years but Sarah disagrees and claims that television **4** will be cheaper. Use the data to determine who is right. [3]
Space for calculations.

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(iv) Other than to save money, why should consumers be encouraged to choose appliances that use less energy? [2]

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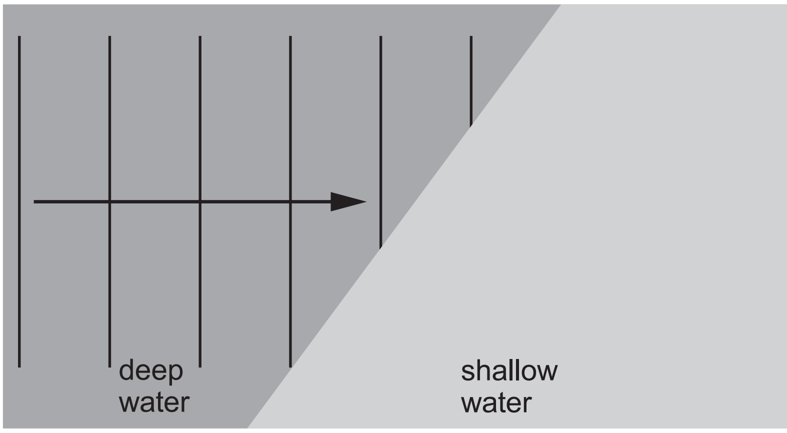
2. A physics teacher demonstrates the refraction of water waves in a ripple tank.

(a) **Complete the diagram below** to show the wavefronts in the shallow water. [2]



(b) The wave generator in the deep water produces 5 waves in 10 s. Use an equation from page 2 and a measurement from the diagram to determine the speed of the waves in the deep water. Give your answer in m/s. [3]

Wave speed = ... m/s.

(c) State how the frequency, wavelength and wave speed will compare in deep and shallow water. [3]

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3. Describe how the density of a small pebble, which is not a regular shape, can be determined. [6 QER]

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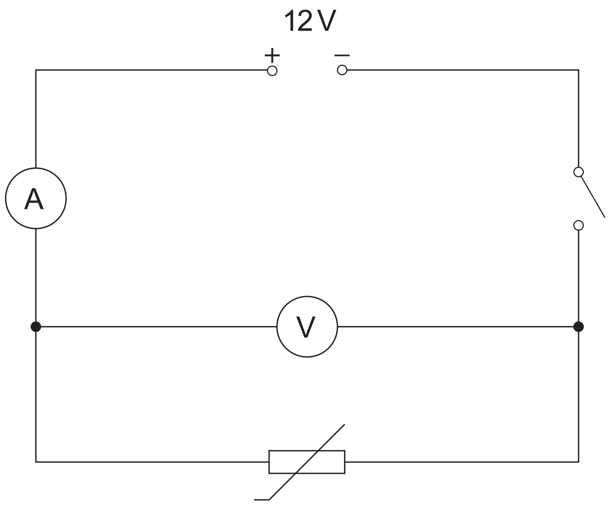
4. A thermistor is a type of resistor whose resistance depends on temperature. Thermistors are often used as temperature sensors in applications where we want to monitor or control temperature. A group of students immerse a thermistor and a thermometer in water in order to determine the resistance at different temperatures. The circuit they use is shown below.



Their results are given below.

Temperature (°C)	Current (mA)	Voltage (V)	Resistance (kΩ)
20	0.97	12.0	12.4
40	2.22	12.0	5.41
60	4.80	12.0	2.50
80	9.23	12.0	1.30
100	17.14	12.0	0.70

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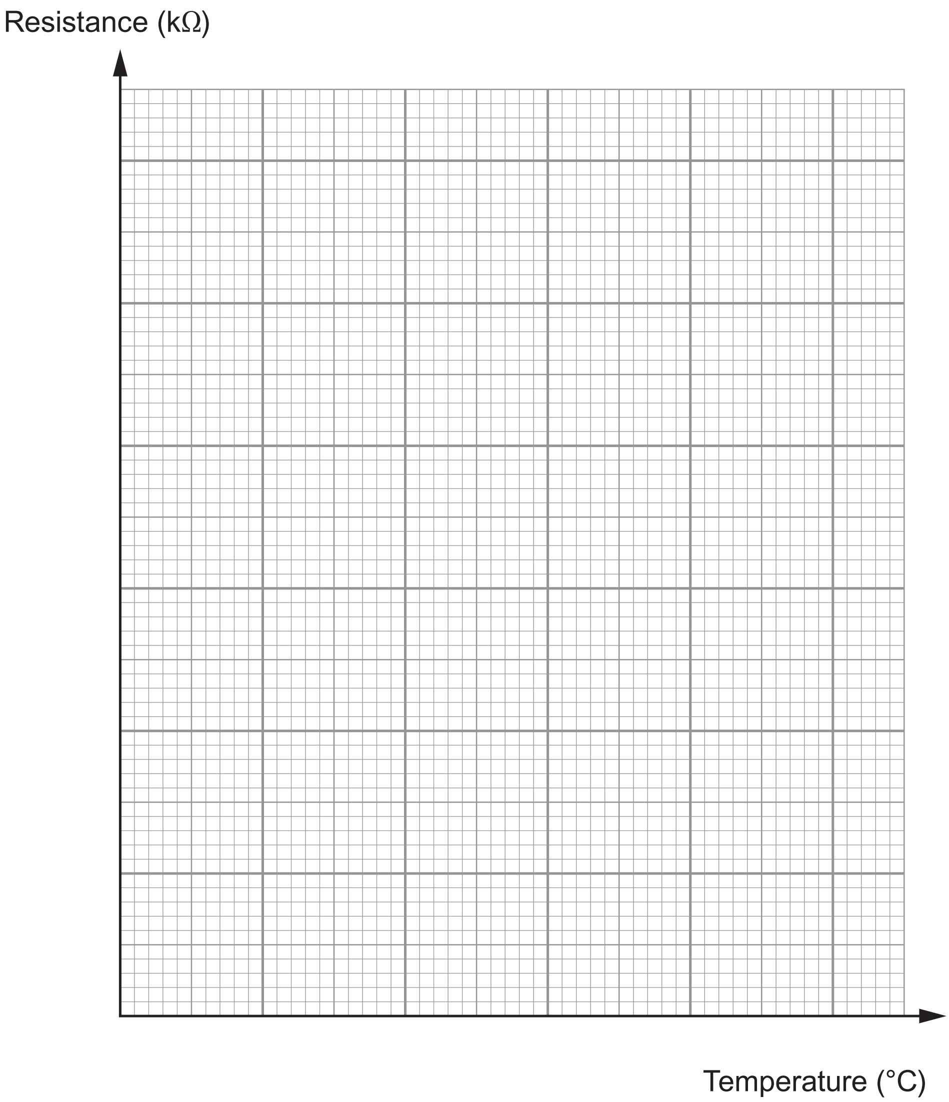
(a) (i) Plot the data on the grid below and draw a suitable line. [4]



(ii) Describe the relationship between temperature and resistance. [2]

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Turn over.

Examiner only

(b) (i) A resistor of resistance 5 kΩ is now added to the original circuit, in parallel with the thermistor which is at a temperature of 30 °C. The same 12 V power supply is used. Use your graph and equations from page 2 to calculate the total current in the circuit. [5]

Current = ... A

(ii) Kim suggests that the current through both the resistor and the thermistor will decrease as the thermistor cools down. Explain whether or not she is correct. [3]

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5. A combined heat and power station uses the wasted heat energy from a power station to provide heating for local homes and businesses. This increases the efficiency of the energy transfers.

(a) Describe how electricity is produced in a fossil fuel power station. [3]

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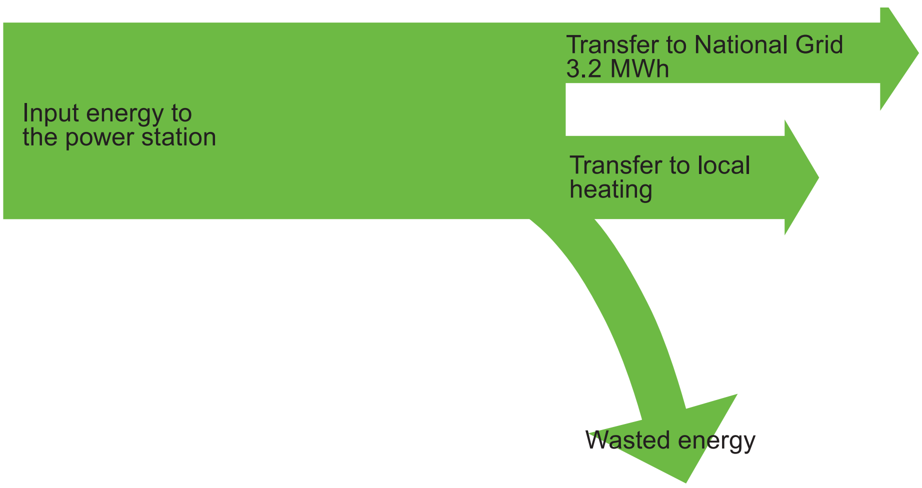
(b) The Sankey diagram shows the energy transfers for a combined heat and power station in a housing development. 75 % of the input energy to the power station is transferred as useful energy, some to the National Grid and some to local heating. 40 % of the useful energy produced by the power station is transferred to the National Grid. Helen estimates the input energy to the power station to be 20 MWh. Determine if this estimate is correct. [3]



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(c) Another power station produces 1 200 MW at a voltage of 50 kV. This voltage is increased to 400 kV by a step-up transformer before being transmitted by the National Grid. Use an equation from page 2 to calculate the current in the wires of the grid. Assume that the transformer is 100% efficient. [3]

Current = ... A

9

Examiner only

6. Satellites in orbit around the Earth are used for a variety of purposes. One use is communications between base stations and satellites. Satellites for communications are usually put into geostationary orbits, orbiting above the equator. Satellites for other uses such as weather forecasting can be put in polar orbits. The speed of the satellite and therefore its orbital period, the time for one orbit of the Earth, is determined by its orbit height.

(a) Another kind of orbit is a geosynchronous orbit. State **one** similarity and **one** difference between a geostationary and a geosynchronous orbit. [2]

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(b) The table below gives data on the orbits of different satellites.

Satellite	Height above Earth (km)	Period (hours)
1	21 450	12.9
2	24 000	15
3	36 000	24
4	507	1.6
5	1 090	1.8
6	20 200	12

(i) State which satellite is in geostationary orbit. [1]

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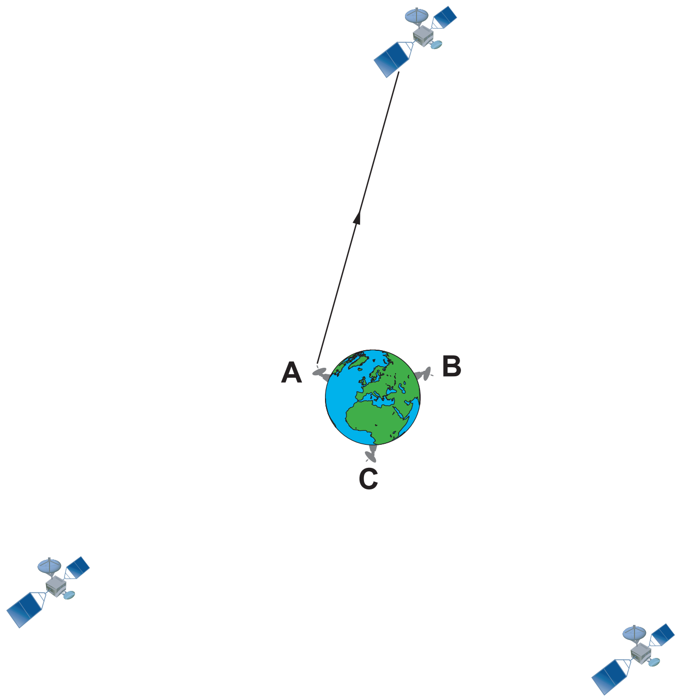
(ii) A signal is sent from base station **A** to a geostationary satellite and is received at another base station after a time delay of 0.48 s. An incomplete diagram of the signal's path is shown.



Use an equation from page 2 to calculate the distance the signal has travelled. The speed of light, $c = 3 \times 10^8$ m/s. [3]

Distance = ... m

(iii) Use your answer to (ii) and the information in the table to determine which base station, **A**, **B** or **C**, finally receives the signal. Show all your workings. [2]

Receiving base station = ...

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END OF PAPER

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