Q1. (a) The student is using a microphone connected to a cathode ray oscilloscope (CRO).

The CRO displays the sound waves as waves on its screen. What does the microphone do?

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(2)

(b) The amplitude, the frequency and the wavelength of a sound wave can each be either increased or decreased.

(i) What change, or changes, would make the sound quieter?

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(1)

(ii) What change, or changes, would make the sound higher in pitch?

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(1)

(Total 4 marks)

Q2. The picture shows a food processor, which is used to grate, shred, liquidise and mix food. The table gives some information about the food processor.

Energy input	Electrical
Useful energy output	Kinetic
Power rating	1200 watts
Efficiency	0.8

(a) The food processor is used for a total of 30 minutes a day.

Calculate the cost of the energy **wasted** by the food processor each day.

Electricity costs 15 p per kilowatt-hour.

Write down the equations you use, and then show clearly how you work out your answer.

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Cost of **waste** energy = ... p

(4)

(b) Explain what happens to the waste energy.

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(2)

(Total 6 marks)

Q3. (a) The table gives information about some ways of reducing the energy consumption in a house.

Method of reducing energy consumption	Installation cost in £	Annual saving on energy bills in £
Cavity wall insulation	250	115
Jacket for hot water tank	12	35
Upgraded central heating controls	310	80

Show that over 5 years, the most cost-effective method of reducing energy consumption is to install cavity wall insulation.

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(2)

(b) Any device that transforms energy will waste energy.

Why must the total energy input to such a device always equal the total energy output from the device?

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(1)

(c) A holiday cottage has a pre-payment electricity meter. The electricity is charged at the rate of 20 p per kWh. A £2 coin is put into the meter and a 2.5 kW fire switched on.

Use the equations in the box to work out how many hours it will be before £2 runs out. Assume that no other electrical device is switched on.

energy transferred = power × time total cost = number of kilowatt-hours × cost per kilowatt-hour

Show clearly how you work out your answer.

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Time = ... hours

(2)

(Total 5 marks)

Q4. A homeowner had a new gas boiler installed.

(a) The following information is an extract from the information booklet supplied with the boiler.

Fuel	Natural Gas
Water temperature	60 °C
Energy supplied to gas boiler	8.0 kJ/s (8.0 kW)
Efficiency	0.95

(i) Use the equation in the box to calculate the energy transferred each second by the gas boiler to the water inside the boiler.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Show clearly how you work out your answer.

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Energy transferred by the gas boiler each second = ... kJ

(2)

(ii) The energy value of the gas used in a home is measured in kilowatt-hours (kWh).

The homeowner has a pre-payment meter and pays £30 into his account. With a pre-payment meter, gas costs 15p per kilowatt-hour.

Use the equations in the box to calculate the total number of hours that the gas boiler would operate for £30.

energy transferred = power × time
total cost = number of kilowatt-hours × cost per kilowatt-hour

Show clearly how you work out your answer.

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Number of hours = ...

(2)

(b) Although the gas boiler is very efficient, some energy is wasted.

Explain what happens to the waste energy.

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(2)

(Total 6 marks)

Q5. The table gives data about two types of low energy bulb.

Type of bulb	Power input in watts	Efficiency	Lifetime in hours	Cost of one bulb
Compact Fluorescent Lamp (CFL)	8	20%	10 000	£3.10
Light Emitting Diode (LED)	5		50 000	£29.85

(a) Both types of bulb produce the same useful power output.

(i) Calculate the useful power output of the CFL.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

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Useful power output = ... W

(2)

(ii) Calculate the efficiency of the LED bulb.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

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Efficiency = ...

(1)

(b) Sketch and label a Sankey diagram for the CFL.

(2)

(c) LED bulbs are expensive. This is because of the large number of individual electronic LED chips needed to produce sufficient light from each bulb.

(i) Use the data in the table to evaluate the cost-effectiveness of an LED bulb compared to a CFL.

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(2)

(ii) Scientists are developing brighter and more efficient LED chips than those currently used in LED bulbs.

Suggest **one** benefit of developing brighter and more efficient LED chips.

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(1)

(Total 8 marks)