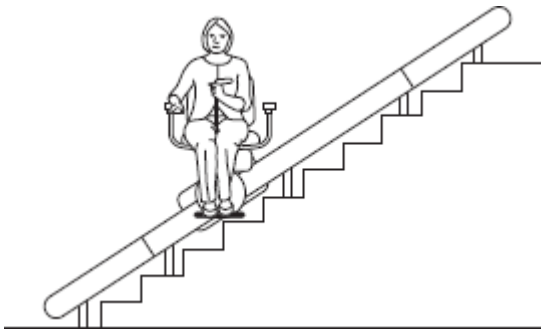
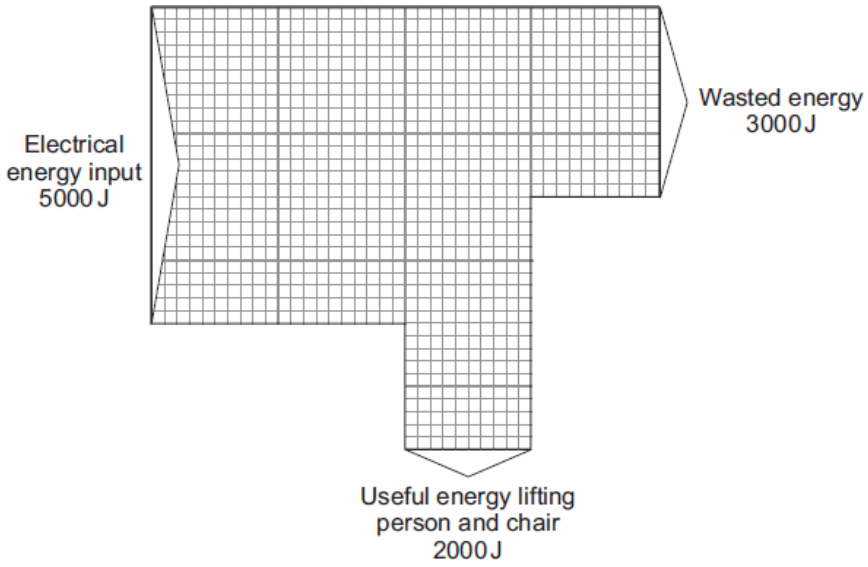
P3.1 Energy Homework energy resources task 1

Q1. A person uses a stairlift to go upstairs. The stairlift is powered by an electric motor.



The Sankey diagram shows the energy transfers for the electric motor.



(a) Complete the following sentence.

The electric motor wastes energy as _____ energy.

(1)

(b) Use the equation in the box to calculate the efficiency of the electric motor.

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

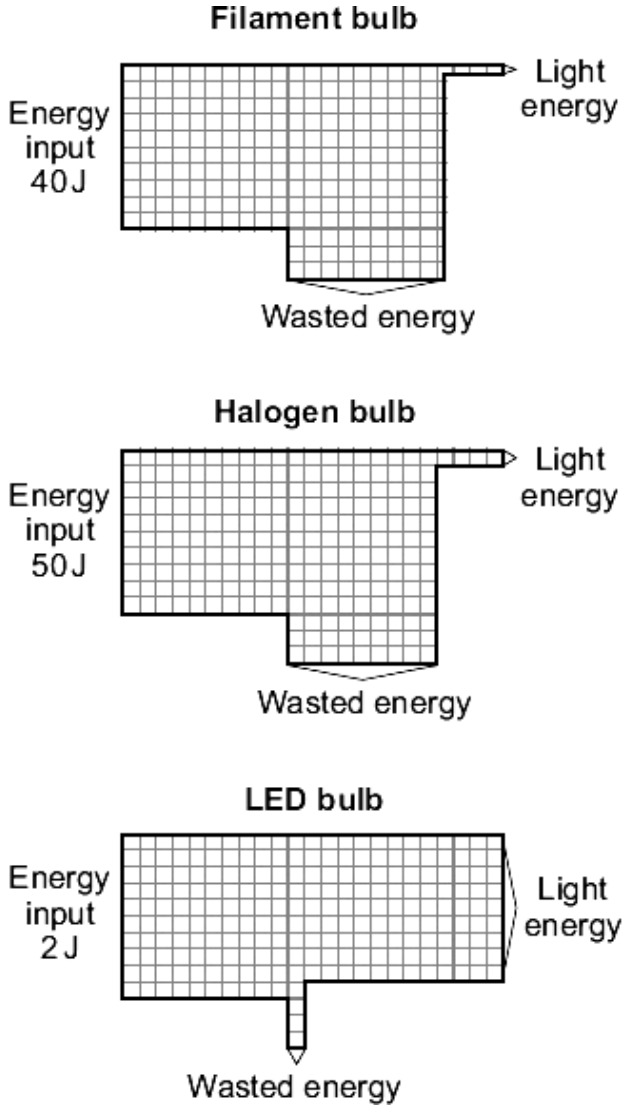
Show clearly how you work out your answer.

_____

_____ Efficiency = _____

(2) (Total 3 marks)

Q2. The Sankey diagrams show the energy transferred to the surroundings each second by three different bulbs.



(a) The filament bulb is the least efficient of the three bulbs.

Explain what *least efficient* means.

_____

_____

_____

_____

(2)

(b) Calculate the percentage efficiency of the halogen bulb.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

_____

_____

_____

_____

Efficiency = _____%

(2)

(c) What effect does the wasted energy from a bulb have on the surroundings?

_____

_____

(1)

(d) Use the Sankey diagrams to give a reason why the overall cost of using an LED bulb is the lowest of the three bulbs.

_____

_____

(1)

(e) The table gives further information about each type of bulb.

Bulb	**Cost to buy in £**	**Average lifespan in hours**
Filament	0.50	1000
Halogen	2.00	2500
LED	15.00	25000

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

(i) Which type of bulb is the most cost-effective?

Give a reason for your answer.

Bulb _____

Reason _____

_____

(2)

(ii) Sales of LED bulbs are increasing.

Suggest **one** reason why.

_____

_____

(1)

(Total 9 marks)

Higher Tier Questions

Q3

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.

Show clearly how you work out your answer.

_____

_____

_____

Useful power output = _____ W

(2)

(ii) Calculate the efficiency of the LED bulb.

Show clearly how you work out your answer.

_____

_____

_____

Efficiency = _____

(1)

(b) 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.

_____

_____

_____ **(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.

_____

_____

(1)

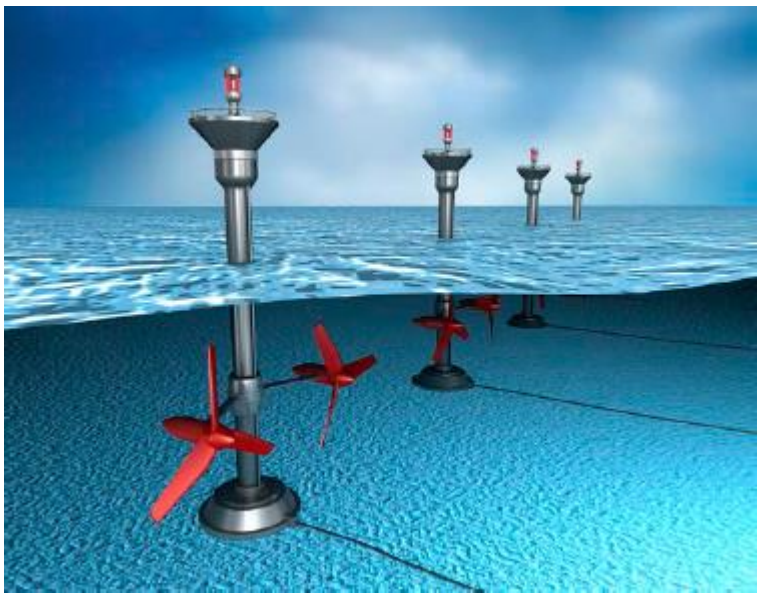
(Total 6 marks)

Q4.

Electricity in the UK is generated in many ways.

The figure below shows an undersea turbine.

The undersea turbine uses tidal energy to generate electricity.



(a) What is the original source of energy for tidal power schemes?

_____

_____

(1)

(b) Explain **two** advantages of using undersea tidal turbines to generate electricity rather than burning fossil fuels.

_____

_____

_____

_____

_____ **(4)**

(c) Some power stations burn wood instead of fossil fuels to generate electricity.

A coal-burning power station burns 6 million tonnes of coal per year.

Coal has an average energy value of 29.25 MJ per kg.

Wood chip from willow trees has an energy value of 13 MJ per kg.

A hectare of agricultural land can produce 9 tonnes of dry willow wood per year.

If this power station burned dry willow wood instead of coal, how much agricultural land would be needed to grow the willow?

Amount of land needed = _____ hectares

(3)

(d) The table below shows the carbon dioxide emissions of four fuels used to generate electricity.

Fuel	**Direct CO_2 emissions in kg per MWh**	**Lifecycle CO_2 emissions in kg per MWh**
Coal	460	540
Natural gas	185	215
Oil	264	313
Wood	2 100	58

Direct CO_2 emissions are the amounts of carbon dioxide released when the fuel is burned.

Lifecycle CO_2 emissions is the total amount of carbon dioxide released during all stages from fuel extraction to when the fuel has been used.

Use the data from the table above to explain why wood is considered to be a low carbon dioxide emitting fuel.

(2)

(Total 10 marks)

Mark schemes

Q1.

(a) heat / thermal
or / and
sound

*do **not** accept noise*
other forms of energy eg light negates answer

1

(b) 0.4
or
40 %

*allow **1** mark for* $\frac{2000}{5000}$
or
equivalent fraction
*an answer 0.4 % gains **1** mark*
*answers 0.4 or 40 given with any unit gains **1** mark*
*40 without % gains **1** mark*

2

[3]

Q2.

(a) highest <u>proportion / percentage</u> of (input) energy wasted

NB this answer gains 2 marks
allow higher / greater
allow ratio
*accept for **1** mark lots of energy wasted*
or
*allow for **1** mark wastes most energy*

2

(b) $efficiency = \frac{useful\ energy\ out\ (\times 100\%)}{total\ energy\ in}$

10 % (or 0.1 if % sign crossed out)

*allow **1** mark for the correct substitution into the correct equation*
eg (5/50) × 100
***or** (1/10) × 100*
*allow **1** mark if 0.1 is given as the answer, but % sign is still present*

2

(c) heats it (the surroundings)

allow given off as heat

or

increases the temperature

ignore global warming

1

(d) low<u>est</u> energy input / needed / used

allow input only 2 J

1

(e) (i) filament (bulb)

*allow **1** mark for filament bulb being chosen provided a reason is given (reason may be incorrect, but sensible eg cheapest)*

1

lifespan is long<u>est</u> for the purchase cost

accept cost per hour is least / hours per £ is most

accept relevant calculation

1

(ii) long<u>est</u> lifespan

allow lasts 25 000 hours

*do **not** accept most cost-effective*

1

[9]

Q3.

(a) (i) $$efficiency = \frac{useful\ energy\ out\ (\times 100\%)}{total\ energy\ in}$$

1.6 (W)

*allow **1** mark for correct substitution ie* $0.2 / \frac{20}{100} = \frac{output}{8}$

2

(ii) $$efficiency = \frac{useful\ energy\ out\ (\times 100\%)}{total\ energy\ in}$$

32 (%) / 0.32
or
their (a)(i) ÷ 5 correctly calculated

ignore any units

1

(b) (i) any **two** from:

- comparison over same period of time of relative numbers of bulbs required eg over 50 000 hours 5 CFL's required to 1 LED

  accept an LED lasts 5 times longer

- link number of bulbs to cost eg 5 CFL's cheaper than 1 LED

  an answer in terms of over a period of 50 000 hours CFLs cost £15.50 (to buy), LED costs £29.85 (to buy) so CFLs are cheaper scores both marks

an answer in terms of the cost per hour (of lifetime) being cheaper for CFL scores 1 mark if then correctly calculated scores both marks

- over the same period of time LEDs cost less to operate (than CFLs)

2

(ii) any **one** from:

- price of LED bulbs will drop
  *do **not** accept they become cheaper*
- less electricity needs to be generated
  accept we will use less electricity
- less CO_2 produced
- fewer chips needed (for each LED bulb)
- fewer bulbs required (for same brightness / light)
- less energy wasted
  *do **not** accept electricity for energy*

1

[6]

Q4.

(a) gravity (of moon and sun)

1

(b) any **two** from:

1 mark for statement, 1 mark for correctly linked reason

- tidal energy is renewable (1)
- so won't run out like fossil fuels (1)

or

- doesn't emit carbon dioxide
- so won't contribute to global warming / climate change

or

- doesn't emit oxides of sulfur or nitrogen
- so doesn't cause acid rain

or

- doesn't use fossil fuels
- so less impact on environment of extraction / transport

or

- doesn't produce particulates
- so less effect on health / environment

Max. 4

(c) coal consumption per year = 29.25 × 1000 × 6 million = 175 500 000 000 MJ **1**

1 hectare of willow will produce 9 × 13 × 1000 = 117 000 MJ per year **1**

so need 175 500 000 000 ÷ 117 000 = 1 500 000 (hectares) **1**

*allow 1 500 000 with no working shown for **3** marks*

(d) although has higher direct emissions than other fuels **1**

it has much lower lifetime emissions **1**

[10]