

**4-1 / 6-1 Energy – Physics and Trilogy**

**1.0** A weightlifter picks up a barbell.



**1.1** Which type of energy is stored in the barbell when it is held above the weightlifter's head?

**[1 mark]**

Tick **one** box.

- Chemical potential
- Elastic potential
- Gravitational potential
- Kinetic

**1.2** The weightlifter drops the barbell.

The barbell's store of which type of energy increases as the barbell falls.

**[1 mark]**

Tick **one** box.

- Chemical potential
- Elastic potential
- Gravitational potential
- Kinetic

**1.3** Use the data in **Table 1** to draw a line between each calculation and the energy change it is calculating.

Draw **two** lines only.

**Table 1**

mass of barbell	50 kg
gravitational field strength	9.8 m/s <sup>2</sup>
height the barbell drops	2 m
maximum speed the barbell drops	6.2 m/s

[1 mark]

**Calculation**

**Increase/decrease in**

$$50 \times 9.8 \times 2$$

Chemical potential energy

Elastic potential energy

$$\frac{1}{2} \times 50 \times 6.2 \times 6.2$$

Gravitational potential energy

Kinetic energy

**1.4** The weightlifter's internal store of energy decreased when he lifted the bar.

The bar's internal store of energy increased by a smaller amount.

Explain why.

[2 marks]

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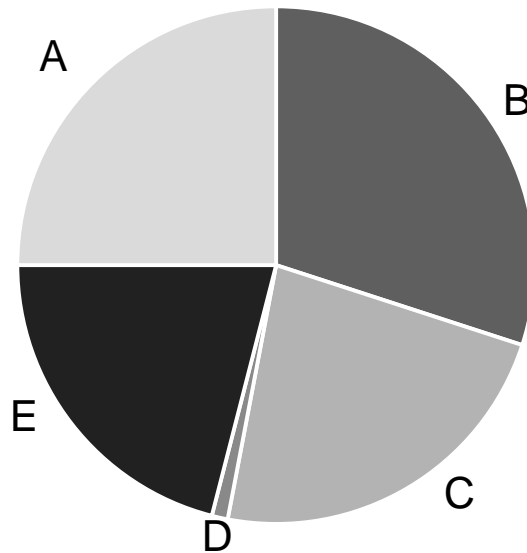
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**2.0** Electricity in the UK is produced from a number of energy resources.

**Figure 1** below shows the proportion of each energy resource used.

The labels have been removed from the pie chart.

**Figure 1**



**2.1** Complete the table.

[2 marks]

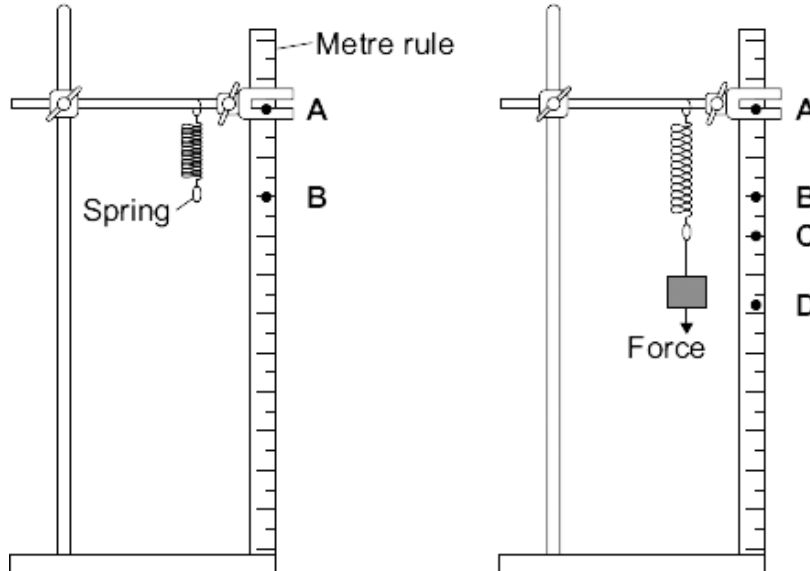
Energy resource	Percentage of UK electricity production	Segment label
Coal	23	
Natural gas	30	
Nuclear power	21	
Oil	1	
Renewable fuels	25	A



3.0 A student investigated how the extension of a spring depends on the force applied to the spring.

Figure 2 shows the spring before and after a force has been applied.

**Figure 2**



3.1 The distance between each large mark on the rule is 10cm. Point A is on a large mark. State the length of the spring and the extension after the force is applied.

[1 mark]

Length of spring = \_\_\_\_\_ cm

Extension = \_\_\_\_\_ cm

3.2 The stretched spring stores elastic potential energy. The elastic potential energy stored in a spring can be found by using the equation:

$$\text{Elastic potential energy} = 0.5 \times \text{spring constant} \times (\text{extension})^2$$

A particular spring has a spring constant of 25 N/m.

Calculate the energy stored when the spring is extended by 15 mm.

Give your answer in standard form, to 3 significant figures.

[3 marks]

Energy stored = \_\_\_\_\_ J

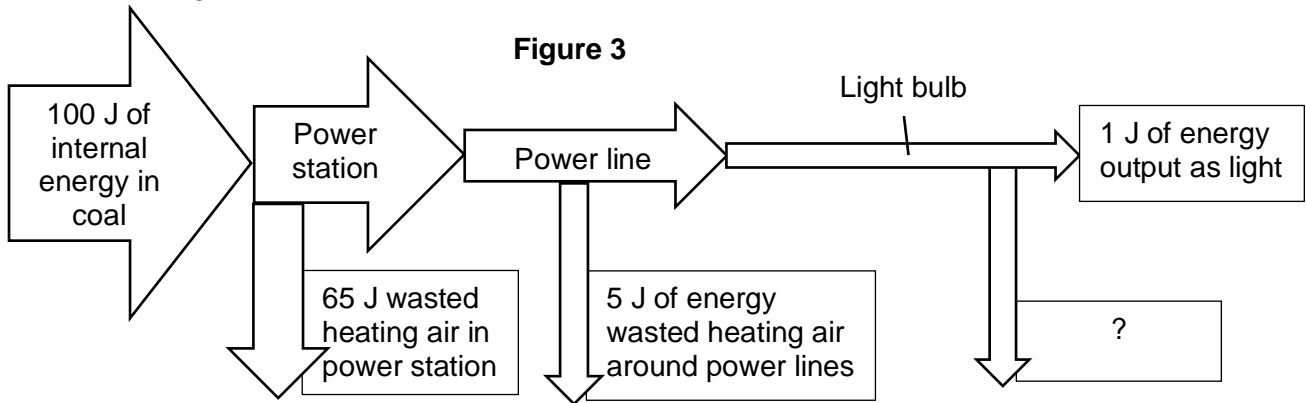
3.3 Another student calculated that the energy stored in her spring was twice the amount of energy for half the extension.

Calculate the spring constant of this spring.

[3 marks]

Spring constant = \_\_\_\_\_ N/m

**4.0** Figure 3 shows the amount of energy lost at various stages in producing light from an electric light bulb.



**4.1** There is no information on one of the energy labels.  
What should it say?

[1 mark]

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**4.2** An electricity company wants to reduce wasted energy across a town.

For the same amount of money, they can either:

- Use 20% of the wasted energy from the power station to heat their offices
- Install new power lines which only waste half the energy of the old ones
- Replace all the bulbs in the town with LED bulbs, which are 99% efficient.

Explain which of these things they should do.

[2 marks]

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**4.3** The lightbulb's manufacturer says that the lightbulb is 5% efficient. Is this correct?

Use a calculation to justify your answer.

[2 marks]

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**4.4** Another lightbulb has a power of 12 W. It has an efficiency of 80%.

Calculate the amount of time taken in seconds for the bulb to transfer 300 J of energy into light energy.

[3 marks]

Time taken = \_\_\_\_\_ s

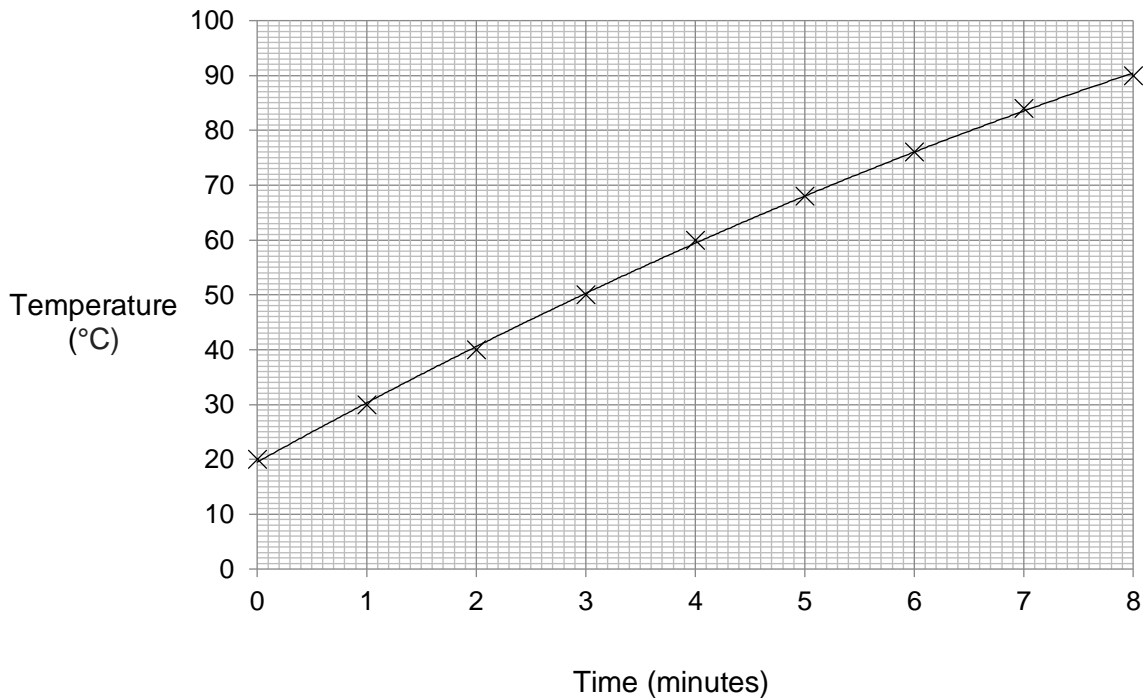






**6.0** A student heated a beaker of water and measured the temperature every minute for 8 minutes. **Figure 4** shows the results of their experiment.

**Figure 4**



**6.1** The mass of water used was 450 g.  
 The power of the heater is 300 W.  
 Calculate the specific heat capacity of the water.

[3 marks]

Specific heat capacity = \_\_\_\_\_ J/kg°C

**6.2** The result of this experiment is higher than the accepted value for water.  
 Suggest **two** reasons why this might be.

[2 marks]

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**MARK SCHEME**

Qu No.		Extra Information	Marks
1.1	Gravitational potential		1
1.2	Kinetic		1
1.3	50 × 9.8 × 2 – Gravitational potential ½ × 50 × 6.2 × 6.2 – Kinetic	Both required for the mark	1
1.4	Energy lost to the surroundings		1
	Named example (eg air gained internal energy)	Accept heat / air got warmer / sound	1

Qu No.		Extra Information	Marks										
2.1	<table border="1"> <tr> <td>Coal</td> <td>C</td> </tr> <tr> <td>Natural gas</td> <td>B</td> </tr> <tr> <td>Nuclear power</td> <td>E</td> </tr> <tr> <td>Oil</td> <td>D</td> </tr> <tr> <td>Renewable fuels</td> <td>A</td> </tr> </table>	Coal	C	Natural gas	B	Nuclear power	E	Oil	D	Renewable fuels	A	2 marks for all four correct 1 mark for 2 correct	2
Coal	C												
Natural gas	B												
Nuclear power	E												
Oil	D												
Renewable fuels	A												
2.2													
<b>Level 3</b>	Clear, coherently organised answer. Clear understanding of the overall energy needs of the country. Understands the need for a range of resources. Discusses both renewable and non-renewable energy resources, making clear points about each.		5– 6										
<b>Level 2</b>	Some structure to answer. Some discussion of the overall energy needs of the country. Discusses a range of resources, giving advantages and disadvantages, although these may not be coherently linked.		3– 4										
<b>Level 1</b>	Limited structure to answer. Some discussion of a number of resources with limited link to the overall energy needs of the country.		1– 2										
<b>Level 0</b>	No relevant content.		0										
<b>Indicative content</b>													
<ul style="list-style-type: none"> <li>• Same or greater overall energy required and/or efficiency savings mean potentially less energy required.</li> <li>• Fossil fuels plentiful in supply.</li> <li>• Fossil fuels contribute to global warming.</li> <li>• Unlikely to be time to set up new nuclear fuel plants.</li> <li>• Renewable energy resources expensive to set up.</li> <li>• Renewable energy resources can be inefficient.</li> <li>• Wave, hydro and/or wind likely to be useful for the UK.</li> <li>• Solar power less likely to be useful.</li> <li>• Biomass has negatives in land use and fertilisers etc.</li> </ul> <p>Ignore discussion of nuclear waste etc.</p>													



Qu No.	Extra Information	Marks
5.1		
<b>Level 3</b>	Clear, coherently organised answer. Method complete with clear understanding of the experimental requirements and how the data would be analysed.	5-6
<b>Level 2</b>	Some structure to answer. Main steps in method covered, with some errors or omissions. Limited expression of data analysis.	3-4
<b>Level 1</b>	Limited structure to answer. Some steps described, with little or no control variables. No data analysis.	1-2
<b>Level 0</b>	No relevant content.	0
<b>Indicative content</b>		
<ul style="list-style-type: none"> <li>Heat a known mass of water.</li> <li>To a known temperature.</li> <li>Transfer the water to a beaker lagged with the first material.</li> <li>Cover the beaker with a lid of the same material.</li> <li>Record the temperature and start a clock.</li> <li>Record the temperature drop after a fixed time.</li> <li>Repeat using the same mass of water with the other materials.</li> <li>Determine which material has the smallest temperature drop in a given time/longest time for a given temperature drop.</li> <li>This will be the most effective material.</li> </ul>		

Qu No.	Extra Information	Marks
6.1	Energy supplied = power $\times$ time $= 300 \times 8 \times 60$ $= 144 \times 10^3 \text{ J}$ Temperature rise = $70^\circ\text{C}$ Mass = 0.45 kg Specific heat capacity = $E/(m.\Delta\theta)$ $= 144 \times 10^3 / (0.45 \times 70)$ $= 4.6 \times 10^3 \text{ J/kg } ^\circ\text{C}$	          1          1 1
6.2	Any <b>two</b> from: <ul style="list-style-type: none"> <li>Loss of heat to surroundings</li> <li>Heat absorbed by the beaker</li> <li>Evaporation</li> <li>Inaccurate thermometer/clock/balance</li> </ul>	2