Physics - Key stage 4 - Energy

Insulating material required practical part 1 (Physics only) - worksheet

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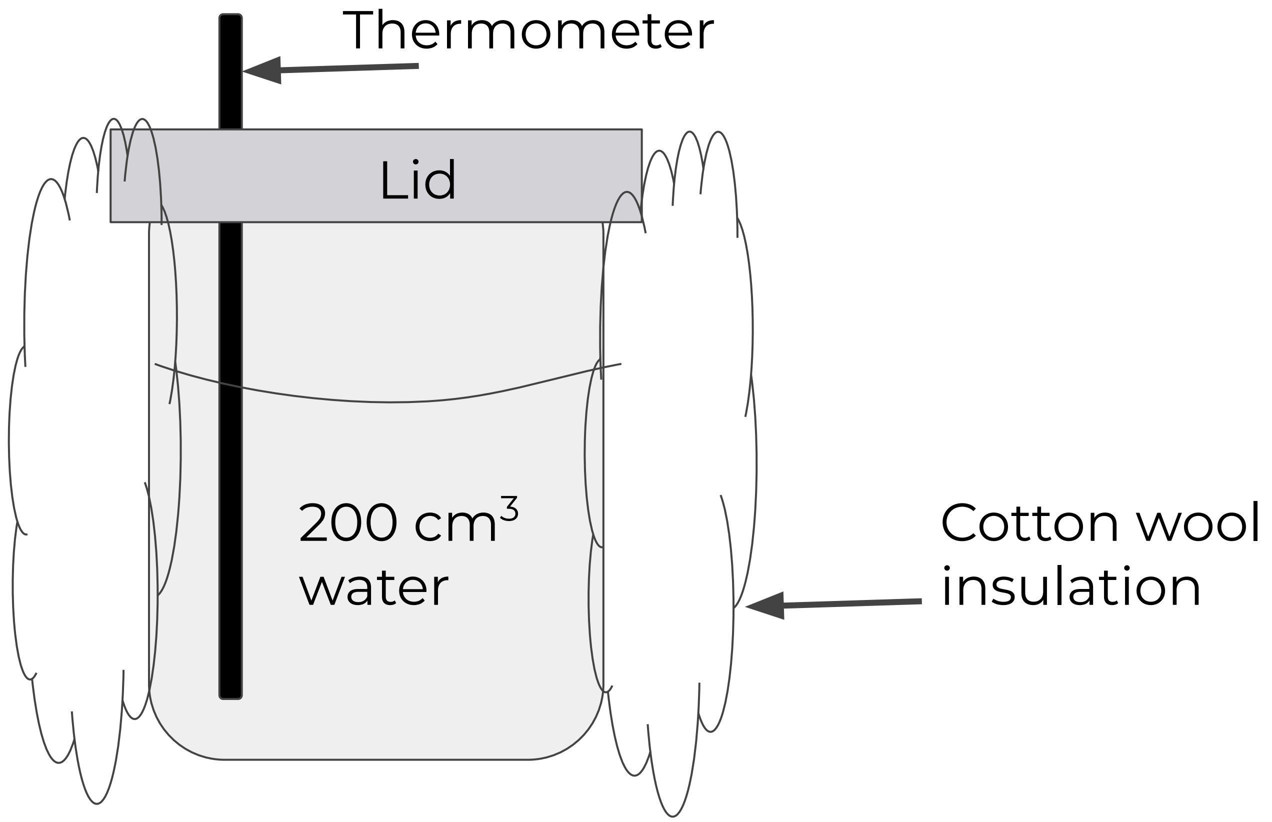
Exam style question

A student investigated how the thickness of insulation affects the cooling of a beaker of hot water.

The student wraps cotton wool around the beaker and measure the temperature at the start and after 15 minutes.

Describe a method the student could have used to obtain the results shown. **[6]**

Thickness of cotton wool / mm	Start temperature / °C	End temperature / °C	Temperature change / °C
0	90	65	25
2	90	67	23
4	90	69	21
6	88	69	19
8	88	71	17
10	90	75	15



Answers

Points to include

- Wrap cotton wool around the beaker
- How the water has been heated (kettle / bunsen burner)
- Measuring the volume of water with a measuring cylinder.
- Pouring the water into the beaker
- Putting a lid on top of the beaker
- Measure initial and final temperature using thermometer
- Use stopwatch / stopclock to measure 10 minutes.
- Calculate temperature decrease
- Repeat with different thicknesses (specify 0 - 10 mm) of cotton wool
- Repeat with same volume of water - control variable

Level 3: The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced. **5–6**

Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced. **3–4**

Level 1: The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear. **1-2**

No relevant content: **0**

In lesson questions

Step	**Reason**
1. **Put** the **small beaker** inside the larger beaker.	To produce reliable results with the same size beaker
2. Use the **kettle** to **boil water. Put 80 cm^3** of this hot water into the **small beaker**.	This is the control variable and sets the starting point
3. **Use a piece of cardboard** as a lid for the **large beaker**. The cardboard must have a hole for the thermometer.	
4. **Put the thermometer** through the hole in the **cardboard lid** so that its bulb is in the hot water. Leave it for 1 minute	
5. **Record** the temperature of the water using a **thermometer and start the stopwatch.**	
6. **Record** the **temperature** of the water every 3 minutes for 15 minutes.	

Design a method

Write a method to investigate the effect of thickness on cooling rate of water.

1. *Wrap .... layers of insulating material around the beaker, holding it in place with a rubber band. Do not add insulating material to the bottom of the beaker.*
2. *Put .... of .... into the beaker.*
3. *Add a ....*
4. *Insert the ....*
5. *Record ....*
6. .....
7. .....

- Independent variable - range, interval
- Dependent variable
- Reducing uncertainty - which is the biggest losses

Answers

Step	**Reason**
1. **Put** the **small beaker** inside the larger beaker.	To produce reliable results with the same size beaker
2. **Use** the **kettle** to **boil water. Put 80 cm^3** of this hot water into the **small beaker**.	This is the control variable and sets the starting point
3. **Use a piece of cardboard** as a lid for the **large beaker**. The cardboard must have a hole for the thermometer.	To reduce heat transfer out the top of the beaker
4. **Put the thermometer** through the hole in the **cardboard lid** so that its bulb is in the hot water. Leave it for 1 minute	So we can measure the dependent variable
5. **Record** the temperature of the water using a **thermometer and start the stopwatch.**	Measuring dependent variable
6. **Record** the **temperature** of the water every 3 minutes for 15 minutes.	

Design a method

Write a method to investigate the effect of thickness on cooling rate of water.

1. ***Wrap two layers*** *of* ***insulating material around the beaker****, holding it in place with a rubber band. Do not add insulating material to the bottom of the beaker.*
2. ***Put 80 cm^3*** *of hot water into the* ***beaker.***
3. ***Add*** *a lid to the* ***beaker****.*
4. ***Insert*** *the* ***thermometer*** *through the hole in the lid so that its bulb is in the hot water.*
5. ***Record*** *the* ***temperature*** *of the water using a* ***thermometer*** *and start the* ***stopwatch****.*
6. ***Record*** *the* ***temperature*** *of the water every* ***3 minutes for 15 minutes****.*
7. ***Repeat*** *with* ***2*** *more layers of* ***newspaper added****.*
8. ***Repeat*** *until values for* ***0 - 10 layers*** *have been collected.*