Heating and cooling substances Worksheet

Mr Charman

Exam question

Exam question

1)

A wooden block has a mass of 2 kg and a specific heat capacity of 2000 J/kg °C.

Calculate the energy needed to raise its temperature by 6 °C.

Use the equation:

Change in thermal energy = Mass × Specific Heat Capacity × Change in Temperature

OCR, Gateway Physics A, Paper J249/02, June 2018.

Exam question

2)Dave experiments heating different materials. He needs to choose a heater to warm some water.

The table shows how much energy different heaters supply in 600 seconds.

Heater	Energy supplied in joules
A	5000
B	10000
C	20000
D	25000
E	35000

Dave needs to increase the temperature of 0.6 kg of water by 12 °C in 600 seconds. Water has a specific heat capacity of 4200 J/kg °C.

Do a calculation to find out which heater Dave needs and state the name of this heater.

OCR, Gateway Physics A, Paper B751/02, Jan 2013.

Answers

Review

1)

Change in thermal energy = Mass × Specific Heat Capacity × Change in Temperature

Change in thermal energy = 2 x 6 x 2000 = 24000 J

2)

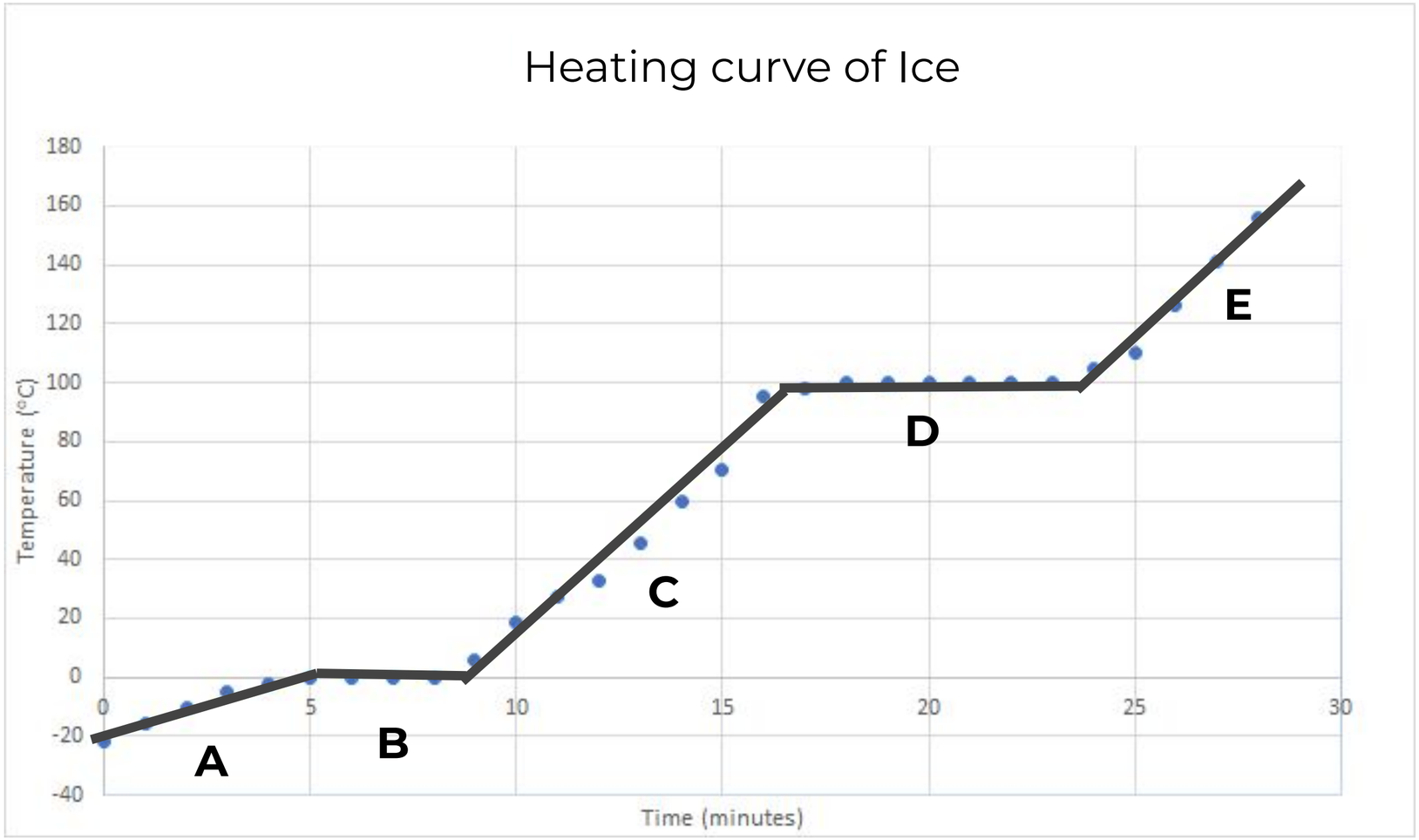
30240 J (1)

E / the 35000 heater (1)

In lesson questions

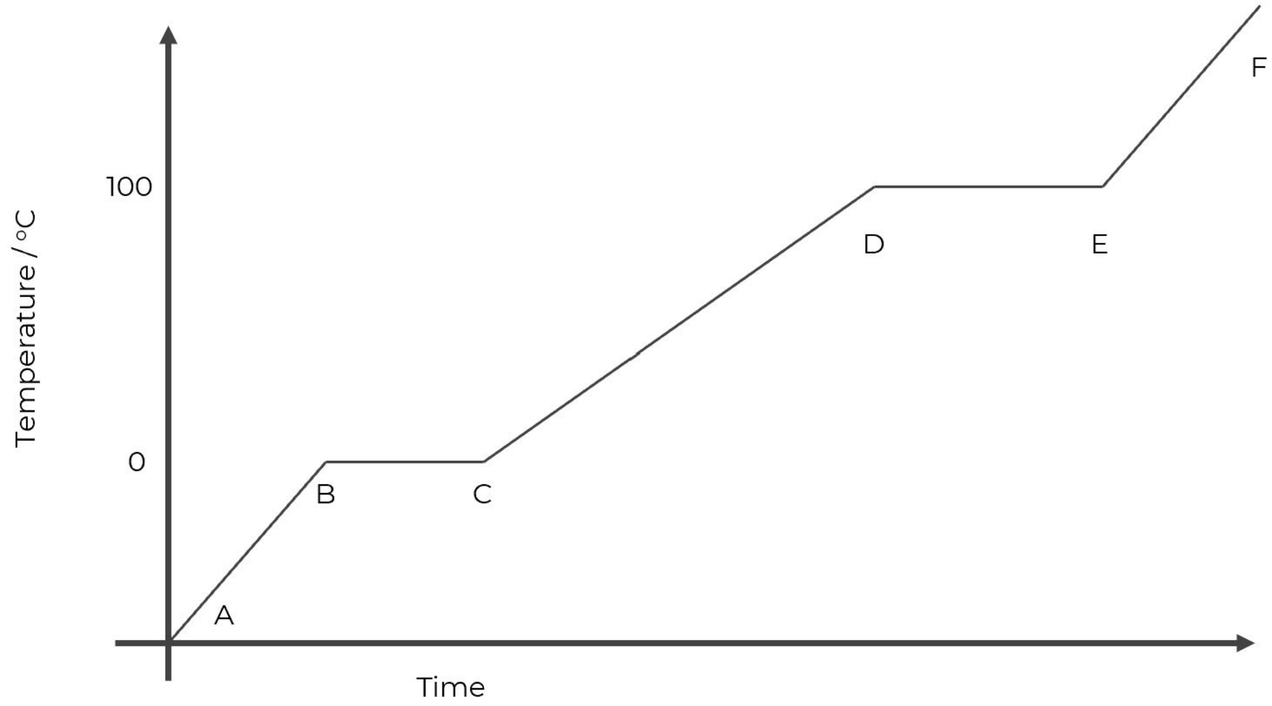
Warm up

1. Identify the stages where the temperature is constant.
2. Identify and label the stages where there is a change of state.
3. For each stage (A-E) write down if the kinetic store or potential store is increasing



Independent practice

1. Describe what is happening at each of these stages on the diagram in terms of potential and kinetic stores for the water molecules:
    a. A-B
    b. B-C
    c. C-D
    d. D-E
    e. E-F



2. **Challenge** - correctly identify and explain the effect on temperature and state of matter for each stage

Pause the video to complete your task

Specific heat capacity

1) Write the definition of specific heat capacity

2) Write down the 3 things that the temperature change of substance depends on when being heated?

Resume once you're finished

Independent practice

Calculate the energy transferred for each of these:

1. m = 1.5 kg and Δθ = 20 °C (for copper)
2. m = 2 kg and Δθ = 80 °C (for oil)
3. m = 4 kg and Δθ = 8 °C (for water)
4. m = 2.2 kg and Δθ = 0.5 °C (for air)
5. m = 2 kg and Δθ = 18 °C (for aluminium)
6. **Challenge:** m = 500 000 g and Δθ = 20 °C and state in kJ (for iron)

Material	Specific heat capacity / J/kg °C
Air	100
Aluminium	900
Copper	390
Iron	450
Oil	540
Water	4200

Independent practice

Calculate the mass for each of the following:

1. ΔE = 1 000 J and $\Delta\theta$ = 5 °C (for oil)
2. ΔE = 2000 J and $\Delta\theta$ = 2 °C (for aluminium)
3. ΔE = 600 J and $\Delta\theta$ = 4.5 °C (for copper)
4. ΔE = 5,000,000 J and $\Delta\theta$ = 25 °C (for water)
5. **Challenge:** ΔE = 0.1 kJ and $\Delta\theta$ = 80 °C (for oil) and state in g.

Material	Specific heat capacity / J/kg °C
Air	100
Aluminium	900
Copper	390
Iron	450
Oil	540
Water	4200

Independent practice

Calculate the temperature change for the following:

1. ΔE = 4 000 J and m = 20 kg (for copper)
2. ΔE = 1 000 J and m = 0.5 kg (for air)
3. ΔE = 70 000 J and m = 10 kg (for aluminium)
4. ΔE = 200 J and m = 0.05 kg (for oil)
5. **Challenge:** ΔE = 20 kJ and m = 2500 g (for water)

Material	Specific heat capacity / J/kg °C
Air	100
Aluminium	900
Copper	390
Iron	450
Oil	540
Water	4200

Exam question

A plastic beaker containing water is heated in the microwave. The plastic beaker has a mass of 0.2 kg and the specific heat capacity of the plastic is 1680 J / kg ° C.The water has a mass of 0.6 kg and its specific heat capacity is 4200 J / kg °C.

The energy from the microwave is initially absorbed by the water which then heats the plastic beaker. The plastic beaker and water experience different temperature rises. The plastic beaker gains 13 440 J and the water gains 151 200 J.

Calculate the temperature rise of the water and the temperature rise of the plastic beaker.

OCR, Gateway Physics A, Paper B751/02, June 2016.

Answers

Review

Warm up

1. Identify the stages where the temperature is constant.

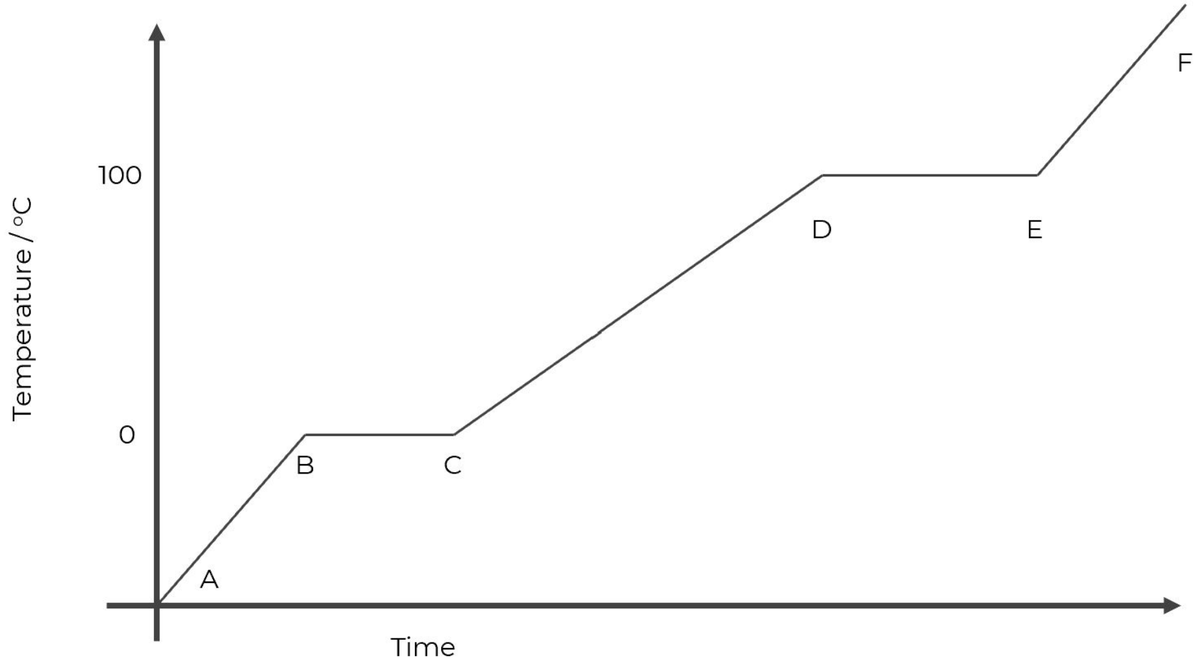
   B and D
2. Identify and label the stages where there is a change of state.

   B - melting, D - Boiling
3. For each stage (A-E) write down if the kinetic store or potential store is increasing.

   A, C and E - kinetic energy store increasing. B and D - potential energy store increasing.

Review

1. Describe what is happening at each of these stages on the diagram in terms of potential and kinetic stores for the water molecules:
    a. A-B **Kinetic store increasing**
    b. B-C **Potential store increasing**
    c. C-D **Kinetic store increasing**
    d. D-E **Potential store increasing**
    e. E-F **Kinetic store increasing**



2. **Challenge** - correctly identify and explain the effect on temperature and state of matter for each stage. **Temperature increasing during stages A-B, C-D and E-F. The temperature is constant during stages B-C and D-E.**

Review - Specific heat capacity

1. Specific heat capacity is defined as the **energy** required to raise the **temperature** of **1 kilogram** of a substance by **1 °C**

2. The temperature change depends on:
   a. **mass**
   b. **specific heat capacity**
   c. **the amount of energy transferred.**

Review

Calculate the energy transferred for each of these:

1. m = 1.5 kg and Δθ = 20 °C (for copper) **11700 J**
2. m = 2 kg and Δθ = 80 °C (for oil) **86400 J**
3. m = 4 kg and Δθ = 8 °C (for water) **134400 J**
4. m = 2.2 kg and Δθ = 0.5 °C (for air) **110 J**
5. m = 2 kg and Δθ = 18 °C (for aluminium) **32400 J**
6. **Challenge:** m = 500 000 g and Δθ = 20 °C and state in kJ (for iron) **4500 kJ**

Review

Calculate the mass for each of the following:

1. ΔE = 1 000 J and $\Delta\theta$ = 5 °C (for oil) **0.37 kg**
2. ΔE = 2000 J and $\Delta\theta$ = 2 °C (for aluminium) **1.1 kg**
3. ΔE = 600 J and $\Delta\theta$ = 4.5 °C (for copper) **0.34 kg**
4. ΔE = 5,000,000 J and $\Delta\theta$ = 25 °C (for water) **48 kg**
5. **Challenge:** ΔE = 0.1 kJ and $\Delta\theta$ = 80 °C (for oil) **2.3 g** and state in g.

Review

Calculate the temperature change for the following:

1. ΔE = 4 000 J and m = 20 kg (for copper) **0.51 °C**
2. ΔE = 1 000 J and m = 0.5 kg (for air) **20 °C**
3. ΔE = 70 000 J and m = 10 kg (for aluminium) **7.8 °C**
4. ΔE = 200 J and m = 0.05 kg (for oil) **7.4 °C**
5. **Challenge:** ΔE = 20 kJ and m = 2500 g (for water) **1.9 °C**