1. Which change of state releases energy?

A Condensing
B Evaporating
C Melting
D Sublimating

Your answer ☐ **[1]**

2. Ice at 0 °C is heated until it turns into water at 25 °C. The mass of the ice is known.

Which extra information is needed to calculate the energy required for this change?

Use the Equation Sheet.

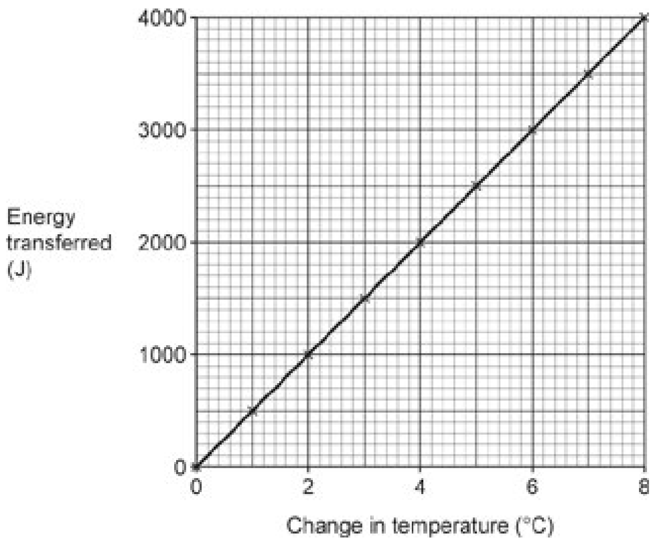
A Specific heat capacity of water and specific latent heat of fusion of ice
B Specific heat capacity of water and specific latent heat of vaporisation of water
C Specific heat capacity of water only
D Specific latent heat of fusion of ice and specific latent heat of vaporisation of water

Your answer ☐ **[1]**

3. A student uses an immersion heater to increase the temperature of 0.25 kg of oil.

The student calculates the energy transferred to the oil.

This is a graph of the student's results.



What is the specific heat capacity of the oil?

Use the graph and the Equation Sheet June 2024, J249-01-02-03-04

A 500 J / kg °C
B 2000 J / kg °C
C 4200 J / kg °C
D 16 000 J / kg °C

Your answer ☐ **[1]**

4(a). A medical freezer is used to keep vaccines cool.

i. Calculate the energy required by the freezer to cool 0.50 kg of solid vaccines from –5 °C to –35 °C.

Assume the specific heat capacity of the vaccines is 1900 J / kg °C.

Use the Equation Sheet June 23 J249-01-02-03-04.

Energy = ... J **[2]**

ii. It takes 5 minutes for the freezer to cool the vaccines.

Calculate the power of the freezer.

Use the Equation Sheet June 23 J249-01-02-03-04.

Power = ... W **[3]**

iii. Suggest **two** reasons why the actual power of the freezer will be greater than that calculated in part **(a)(ii)**.

1 ______________________________

____

2 ______________________________

____

[2]

(b).

i. When the vaccine is used by doctors, it has to be changed back into a liquid. The temperature of the vaccine is first raised to its melting point but it remains as a solid.

Explain **two** reasons why more energy is needed to change the solid vaccine into a liquid at its melting point.

1 ____

____

2 ____

____

[2]

ii. Calculate the number of 5 mg vaccine doses which can be melted using 6800 J of energy.

Assume the specific latent heat of fusion for the vaccines is 340 000 J / kg.

Use the Equation Sheet June 23 J249-01-02-03-04.

Number of vaccine doses = ... **[6]**

5. A submarine in an ocean dives from a depth of 50 m to a depth of 60 m.

What is the change in pressure due to the water acting on the submarine?

Use the Equation Sheet June 23 J249-01-02-03-04.

Density of seawater = 1010 kg / m^3

Use g = 10 N / kg

A 10.1 Pa
B 1010 Pa
C 101 000 Pa
D 606 000 Pa

Your answer ☐ **[1]**

6(a).

Fig. 22.1 shows a sealed cardboard tube containing a ball.

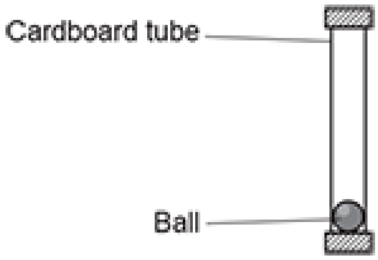


Fig. 22.1

The cardboard tube is quickly turned upside down so that the ball falls the whole length of the tube.
Fig. 22.2 shows the energy stores of the ball at the **top** of the tube.

Complete **Fig. 22.3** to show the energy stores of the ball before it hits the **bottom** of the tube.

[3]

(b).

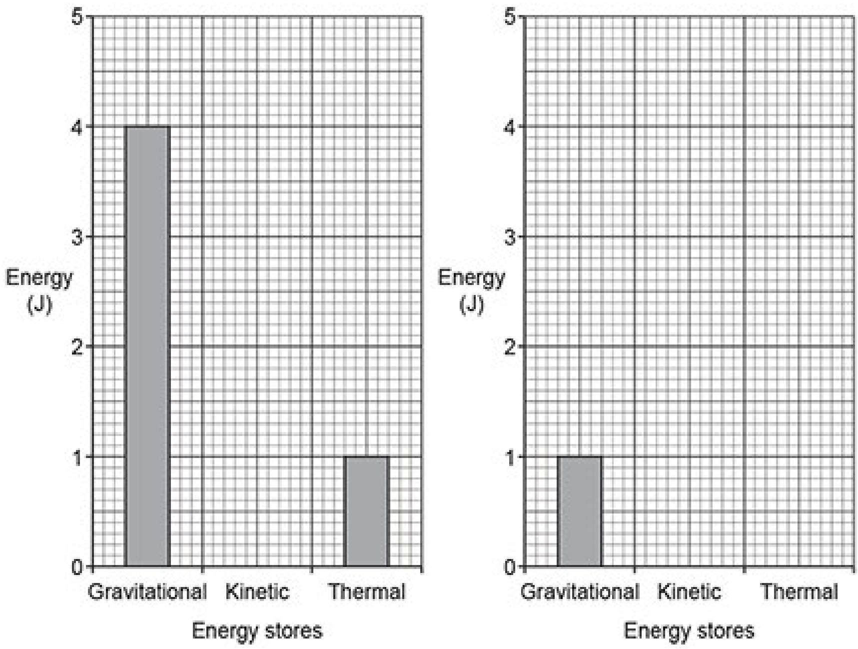


Fig. 22.2 **Fig. 22.3**

Student **A** and student **B** determine the specific heat capacity of lead using this method.

- Measure the mass and initial temperature of small lead pellets.
- Place the pellets in a sealed cardboard tube.
- Quickly turn the tube upside down 40 times.
- Measure the final temperature of the lead pellets.

Fig. 22.4 shows a diagram of the equipment:

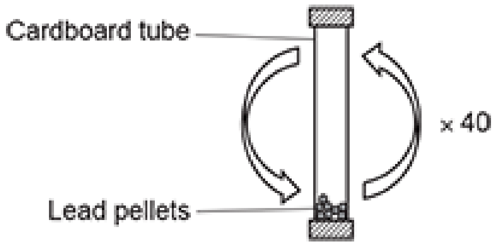


Fig. 22.4

i. State **one** way to improve the experiment.

-- **[1]**

ii. Explain why the cardboard tube is turned upside down very quickly.

-- **[1]**

iii. **Student A** uses 0.030 kg of lead pellets and a 1.5 m long cardboard tube.

Calculate the change in potential energy of the pellets when the tube is turned upside down **once**.

Use the equation: potential energy = mass × height × gravitational field strength

Potential energy = ... J **[2]**

iv. **Student B** repeats the experiment using a different tube.

The total change in potential energy of 0.030 kg of lead pellets for this tube is 21 J.
The temperature change of the lead pellets is 5 °C.

Calculate the specific heat capacity of lead. Include the correct unit.

Use the Equation Sheet June 23 J249-01-02-03-04.

Specific heat capacity = ... Unit .... **[4]**

v. Student **A** says, 'I think we should use a metal with a higher specific heat capacity. This will give us more accurate results.'
Student **B** says, 'I think we should turn the tube upside down 100 times. This will give us more accurate results.'

Explain why both student **A** and student **B** are not correct.

Student **A** ______________________________

____

____

Student **B** ______________________________

____

____

[3]

7(a). A student does an experiment to measure the specific heat capacity of a metal block.

Fig. 20.1 shows the student's equipment.

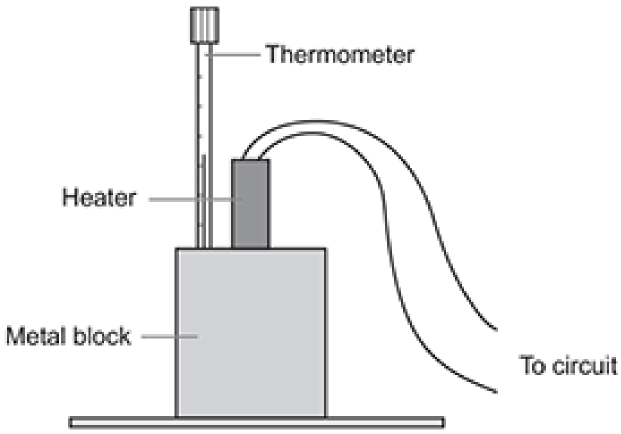


Fig. 20.1

i. The table shows the student's results.

Energy supplied to heater	24 kJ
Starting temperature	20 °C
Final temperature	45 °C
Change in temperature	25 °C
Mass of block	2.0 kg

Use the data in the table to calculate the specific heat capacity of the metal block.

Use the Data sheet_J249 01/02/03/04, June 2022.

Specific heat capacity = ... J / kg °C **[4]**

ii. The value calculated in **(b)(i)** is higher than the actual value.
The student recorded all data correctly.

Suggest why the value calculated is higher than the actual value.

Use **Fig. 20.1**.

____ **[1]**

iii. Suggest how the experiment could be improved.

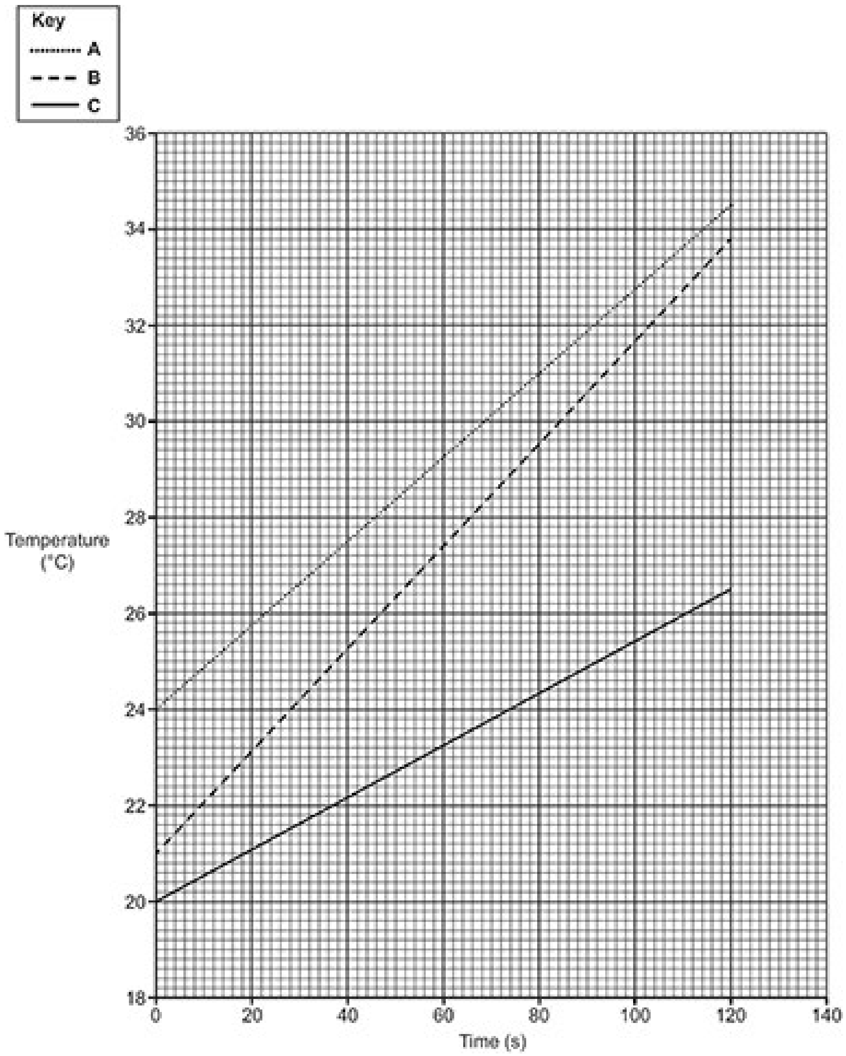
Use **Fig. 20.1**.

____ **[1]**

(b). The student repeats the same experiment using 3 different blocks, **A**, **B** and **C**.

- Each block is made of a different metal but has the same mass.
- The power of the heater stays the same.

The graph shows how the temperature of blocks **A**, **B** and **C** change with time.



Which metal has the **highest** specific heat capacity?

Tick (✓) **one** box.

A ☐

B ☐

C ☐

State a reason for your answer.

___

___ **[2]**

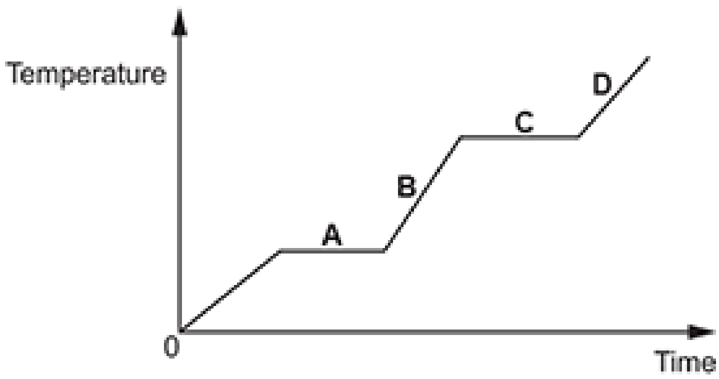
8. The mass of a block of ice at a temperature of 0°C is 2 kg.
The specific latent heat of ice is 3.34×10^5 J / kg.

What amount of energy is needed to melt the block of ice?
Use the Data sheet_J249 01/02/03/04, June 2022.

A 1.67×10^2 J
B 1.67×10^5 J
C 6.68×10^5 J
D 6.68×10^8 J

Your answer ☐ **[1]**

9. A student heats a substance steadily from a solid to a gas. The temperature change is recorded on the graph.



Which section of the graph is where the specific latent heat of vaporisation is used to calculate the energy needed for this change of state?

Your answer ☐ **[1]**

END OF QUESTION PAPER